

February 15, 1960

# Aviation Week

*and Space Technology*

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**First Design  
Details Of  
Vertol YHC-1B**

Delta Convair 440 Jet Transport



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Turns any terrain with this Goodyear soon. Famous Terra-Turn and Roll-Tek tires gear up to give any weapon system the "rollpower" it needs for fast, go anywhere mobility.

Terrains that stop tanks and other vehicles in their tracks—road, snow, deep mud—or even rough and rocky grades—can't halt the Terra-Turn. Secret is its broad, flat "footprint" that rolls easily over soft, unstable surfaces without digging in. These superstrong Terra-Turns carry heavy pay loads into areas barred to other vehicles—yet their ride is so gentle that fragile equipment is cushioned from shock.

Working partner of the Terra-Turn is the unique Roll-Tek tire that carries up to 200 gallons of fuel or liquid supplies. It, too, goes virtually anywhere—floats in water when filled—can be parachute dropped. Low rolling resistance imposes little drag, so towing vehicles can carry major loads as well.

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# GOOD YEAR

Goodrich, Roll-Tek tires—15" & 16" Goodyear Tire & Rubber Company, Akron, Ohio

AVIATION WEEK February 15, 1968



## This is the first space that must be conquered

Two thousand years ago Lucan wrote about a trip to the moon. Today, the two thousand years of dreaming he inspired are close to fulfillment.

Experience in building things from dreams has always been part of Ex-Cell-O. Precision in design, precision in manufacture for forty years has been the Ex-Cell-O tradition. Now as we near the conquest of space, even more important becomes speed of translation from dream to reality. And for this Ex-Cell-O's history and facilities are yours for the asking.

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### AVIATION CALENDAR

- Feb. 25-26**—Seventh International Control Symposium, Hotel Metropole, Bandung, Ind. D. C. Sponsors: American Institute of Electrical Engineers, American League of Communications, Institute of Radio Engineers, National Bureau of Standards.
- Mar. 7-8-9-10**—Annual Business Aircraft Safety Seminar, Douglas Jet Dashore, Spence Flight Safety Foundation.
- Mar. 9-10**—Symposium on Precision Navigation for Airborne Systems, Nassau Hotel, Dayton, Ohio. Sponsors: National Chapter Society of Aircraft Material & Process Engineers.
- Mar. 9-11**—Conference on the Mechanical Properties of Engineering Composites, North Carolina State College, Raleigh, N. C. Sponsors: North Carolina State College School of Engineering, Office of Aerospace Research, U. S. Army.
- Mar. 10-11**—National Flight Techniques Meeting (Invited Speech), Institute of the Aeronautical Sciences, Cleveland.
- Mar. 14-15**—Symposium on Load Carrying Capacity of Structures, American Society of Mechanical Engineers, Eakins Hotel, Dallas, Texas. Sponsors: American Society of Mechanical Engineers, American Society of Naval Engineers.
- Mar. 15**—Defense Planning Seminar, Electronic Industries Association, Statler Hilton Hotel, Washington, D. C.
- Mar. 17-18**—Service Design and Testing Symposium, Department of Commerce Auditorium, Washington, D. C. Sponsors: Department of the Navy Bureau of Naval Weapons.
- Mar. 18-19**—Symposium of Radio Engineers' International Conventions, Waldorf Astoria and Coliseum, New York, N. Y.
- Mar. 21-24**—Symposium on Optical Spectroscopy, Department of High Temperature, University of Chicago, Chicago, Ill. Sponsors: University of Chicago's Applied Science Laboratories, Jacobs Aircraft Co., Vincent Science Foundation.

(Continued on page 6)

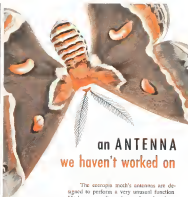
### AVIATION WEEK and Space Technology

February 15, 1968

Vol. 25, No. 7

Look out, space with an additional week to December 31, 1968. This special issue of AVIATION WEEK and Space Technology is a must for all those who are interested in the space program. It contains a wealth of information on the latest developments in space technology, including a special section on the Space Shuttle. The issue is available for \$5.00 per copy. For more information, contact the AVIATION WEEK and Space Technology Department, 1000 North Main Street, Suite 100, North Hollywood, California 91605. Telephone: (818) 706-1000.

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From transmitters, long distance radio antennas to ground telemetry, tracking  
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# TELEMETRY/1923

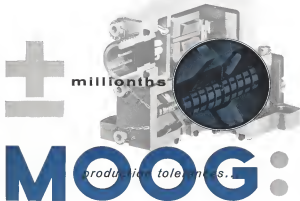


CANOGA

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## AVIATION CALENDAR

- (Continued from page 5)
- Mar. 21-25—General Systems Equipment Conference, American Rocket Society, Stoffer Hotel, Detroit, Mich.
  - Mar. 24-26—Annual Symposium on Human Factors in Electronics, New York, N. Y. Sponsor: Institute of Radio Engineers' Professional Group on Human Factors in Electronics.
  - Apr. 4-5—Tough Colloquium, Combustion and Propulsion Panel, Advisory Group for Aeronautical Research and Development, NACA, Dayton, Ohio. Subject: High Mach Number Air Breathing Engines.
  - Apr. 5-6—1960 National Aeronautics Meeting and Meeting of Astronaut Engineering Display Society of Automotive Engineers, Commodore Hotel, New York.
  - Apr. 6-8—International Design of Space Vehicles Conference, Sheraton Hotel, Santa Barbara, Calif. Sponsor: American Rocket Society's Structures and Materials Committee.
  - Apr. 6-8—1960 National Meeting "Upper Atmosphere—Space Frontier," Institute of Environmental Sciences, Belmont Hotel, Los Angeles, Calif.
  - Apr. 11-13—International Engineering in Space Technology, Sheraton Hotel, Dallas, Tex. Sponsor: American Institute of Electrical Engineers.
  - Apr. 11-15—1960 Annual Spring Technical Conference, Institute of Radio Engineers in conjunction with the American Rocket Society, Sheraton Hotel, Cincinnati, Ohio.
  - Apr. 19-21—International Symposium on Atomic Networks and Feedback Systems, New York, N. Y. Sponsor: Polytechnic Institute of Brooklyn, Department of Defense Research Agency, Institute of Radio Engineers.
  - Apr. 22-23—National Symposium on Manned Space Station, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsor: NASA, the Rand Corp.
  - Apr. 25—Annual Eastern Regional Meeting, Institute of Navigation, Key Binger Marriott Hotel, Washington, D. C.
  - Apr. 21-22—Southwest Meeting of Materials Conference, "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.
  - Apr. 25-26—National Meeting on Space Age Materials, Cosponsor: Chapter of the American Society for Metals, Sheraton Hotel, Cincinnati, Ohio.
  - May 2-4—National Aeronautics Electronics Conference, Belmont and Miramonte Hotels, Dayton, Ohio. Sponsor: Institute of Radio Engineers.
  - May 2-6—1960 National Flight Test Symposium, Instrument Society of America, San Diego, Calif.
  - May 9-11—1960 Symposium of the Institute of Radio Engineers' Professional Group on Vacuum, Theory and Technology, Hotel del Coronado, San Diego.
  - May 11-14—1960 Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.
  - Aug. 15-20-1960 Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm, Sweden.



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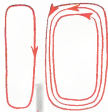
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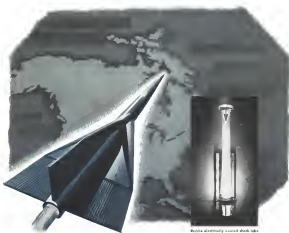
**Plastic Shapes and Pins** are, in essence, this section, threaded parts and precision tolerances are available. Existing facilities and experience in compression and injection molding, extruding, machining of Nylon, Teflon, Delrin<sup>®</sup>, Kel-F.

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Shock electrically caused shock tube can be photographed by observation from test gases

**PLASMA PRODUCTION**

**. . . for magnetohydrodynamic investigations**

Hypersonic flight can generate ionized shock layers with free electron densities as great as 10<sup>19</sup> particles per cc. Temperatures near the stagnation point can be as high as 7000°C. This is the self-generated environment of a missile or aircraft traveling at Mach 20 in the upper atmosphere.

To create these conditions in the laboratory for magnetohydrodynamic and electromagnetic propagation investigations requires a hypersonic wind tunnel. The Bendix electrically excited shock tube is such a research tool. Discharge of a capacitor bank into a nozzle region at one end of the tube instantly creates a shock wave which is driven down the length of the tunnel past the test body. Flow velocities up to 75,000 fps and temperatures of 30,000°C can be generated.

By passing electric and magnetic fields through the plasma in the shock tube, Bendix engineers can measure the attenuation of radio transmission through the ionized layer surrounding hypersonic vehicles. They can also investigate the acceleration of conducting gases for space propulsion, and the feasibility of direct conversion of thermal energy to electrical energy.

Plasma production is one of the projects being carried out at Bendix Systems Division to solve the technical problems which are the keys to the systems of the future. Other investigations include satellite communications systems, navigation aids, advanced infrared reconnaissance, and the EAGLE Air-to-Air Missile System. Engineers are turned from latest engineers also looking to the future.

**Bendix Systems Division**

AN IRVING-CLOUD COMPANY



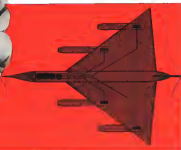


new

THOMAS A.

# EDISON

oil pressure  
indicating system  
withstands vibration  
to 2000 cps at 20g's



Sensor is mounted directly on engine and connected to pump, indicator and alarm system by 3 insulated copper wires.



Indicator is hermetically sealed to ensure life time oil seal. When pressure is lost, needle will drop. Oil pressure indicator is available in 1/4" and 3/8" diameter sizes. Full line of oil pressure indicators is available.

Designed for use on all new jet engines, the new Edison oil pressure indicating system consists of two components — a transmitter and pencil indicator. Because the Model 318 transmitter can withstand vibration to 2000 cps, it may be mounted directly on these engines without shock mountings. As a result, it offers greater reliability, accuracy and speed of response.

Ordinary transmitters must be removed off the engine and then connected by hose or tubing to engine pressure sensor. In sub-zero temperatures oil in hose can thicken and false or delayed pressure indication may result.

The new Model 318 transmitter is 50% smaller and 50% lighter (1.0 lb.) than the model 318 developed by Edison in 1956. It will meet requirements of new specifications MIL-T-36458.

In simplified electro-mechanical design makes installation and maintenance easy. Vibrations transducer has only one moving part and maintains its accuracy in temperatures to 232°C.

For additional information write for publication 3049.

**Thomas A. Edison Industries**  
INSTRUMENT DIVISION

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## Unnoticed Changes in a Metal Cleaning Operation Often Affect Solvent Consumption

We were recently asked by a large user of trichlorethylene for a new procedure for spotting the best number of dollars for this chemical.

The procedure necessary to assure the most economical use of trichlorethylene is neither mysterious nor difficult, but it is precise.

To understand it, it is necessary to accept the fact:

- 1) When a change occurs in the product, or
- 2) When a change occurs in manufacturing, or
- 3) When a change occurs in mixing, or
- 4) When a change occurs in the house element, or
- 5) When a change occurs in the machine —

a change will also occur in the quantity of trichlorethylene being consumed. It is not unusual for one of these changes to occur every month, and many times it will go unnoticed. The only procedure that will get the best result is:

- 1) To ascertain the necessary facts, and
- 2) Have expert appraisal of these facts.

A program can be set up to cover both. We have been doing it for 27 years. We would be very happy to institute such a program for you.

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# Portraits of PERFORMANCE



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Main fuel pumps for the Pratt & Whitney Aircraft engines powering each were engineered and precision produced by Chandler Evans. Significantly, during the first operating year of U.S. commercial jet operations, CECO pumps took part in every single service mile flown by either type of aircraft.

If pictures of missiles and aircraft which are airborne with CECO products actually were exhibited in a gallery, the section devoted to pump applications would be an impressive one. In addition, space would have to be set aside for future portraits, some right now... at Chandler Evans... a number of important pump design and development programs are underway.

**CHANDLER EVANS CORPORATION**  
West Hartford 1, Connecticut

Inviting informative literature on CECO products is placed for the asking. Please address your request to Dept. 33.



## Universal Fluid Coupling and Expansion Joint **FLEXIBILITY-PLUS** in large high pressure missile and aircraft piping installations

### Products of COMPONENTS DEPT., RWD

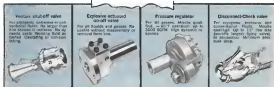
- Qualified for missile and aircraft use
- No pressure limitations
- 3,000,000 life cycles without failure
- 1/2 weight of bellows
- Suitable for conventional and cryogenic fluids
- Smooth internal passageway
- No leakage
- Stands up to wide temperature extremes
- Currently used in Atlas ICBM



An outstanding development in reaction system plumbing, Universal Fluid Couplings permit axial, angular and rotational misalignment and withstand greater lateral displacement than any bellows currently available. They have been qualified for 3" and 9" lines... and are available in line sizes from 4" to 24".

The Universal Fluid Coupling is typical of the advanced design and development capability of Reaction Motors—pioneer of rocket engines, missile components and ground support equipment. Capabilities include all facets of design, development and qualification tests. All phases of experimental and flow tests are performed with Reaction Motors own facilities. Wide experience in handling cryogenic, toxic fluids, conventional fluids. Currently in production on large (11.7") ICBM cryogenic and conventional valves, IRBM regulators, X-15 components and valves for classified projects.

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Components Department REACTION MOTORS DIVISION

**Thiokol** CHEMICAL CORPORATION

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... reports Chemical Division  
Company's High Purity  
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Sure, we at Becco know all the advantages of our high-strength Hydrogen Peroxide—and so do our customers. But we wanted a way to tell a lot more people—so we asked GE if they would give you their comments on our  $H_2O_2$ . Here's what they said:

"1. Becco has met all our delivery requirements for hydrogen peroxide regardless of the size of the order.

"2. Deliveries have never failed to meet our specifications.

"3. The hydrogen peroxide delivered has met all performance requirements. Our decomposers have never failed due to trace elements in the peroxide. Our decomposers have run 67,000 seconds at a fuel rate in excess of two pounds per second with out malfunction.

"4. Storage requirements have been exceeded in all cases."

A few more facts: Becco  $H_2O_2$  is a stable liquid over a wide range of temperatures. Its high density reduces space requirements per unit weight. Its ease of catalytic and thermal decomposition makes for simple and reliable systems.

Write today for our theoretical performance chart and supporting data, as well as technical bulletins describing the properties characteristics and storability of anhydrous  $H_2O_2$ . Address: Dept. AN-8

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New York Liquid Oxygen Tank (left)



New York Liquid Oxygen Tank (right)



Liquid Oxygen Storage in New York



Liquid Oxygen Storage in New York



Liquid Oxygen Storage in New York

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These facilities are the finest in America, especially designed for one purpose—the producing of superior cryogenic products.

Making a variety of equipment for storing, transporting and distributing low temperature liquids, fluid power organizations can be of benefit to your program.

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## The Defense Debate

The running four-year debate over the effectiveness of the United States' defense program in relation to that of the Soviet Union has reached an unprecedented glow in Capitol Hill that indicates it may be a major issue in the fall elections as well as a matter of vital interest to Americans concerned with the survival of our country and its democratic institutions. One of the main difficulties in assessing the merits of the conflicting viewpoints is the better debate is that all contenders are losing their case on a different time period.

For example, the Administration spokesmen in the White House, Senate and Postage who are assuring Americans that all is well, are talking about our military position today. This is, of course, completely irrelevant to the principal issue of the defense debate which is: Are we making the correct decisions today to ensure that our military superiority will continue for the predictable future? As Lt. Gen. Bernard Schriever, chief of the Air Research and Development Command, testified before the Senate, the decision made in 1961 will irreversibly determine our military strength in 1985 just as the (Soviet) economy decision of 1958 and 1959 have made inevitable the potentially disastrous morale gap of 1961-64.

There are several strong indications that the Administration is finding it increasingly difficult to defend its military policy in the face of evidence of Soviet growth in aircraft, missile and space arms which it tried so hard to ignore and designate for so long. First, it has been forced to yield to certain demands in a number of vital areas, although most of these actions are coming about a year later than they should to achieve maximum results. These include:

- Expansion of the Atlas ICBM program demanded by congressional and public critics a year ago when the Fiscal 1968 budget was being debated. The Administration's inaction in the Atlas program, however, surely lacks no more justification at the end of the eight-year-old plan and does not accelerate the current production rates to provide additional capability during the critical years of the missile gap.
- Provisions of mutual, though inadequate, funds to begin preparation for an airborne alert for Strategic Air Command bombers during the period when they will be forced to operate without any certain warning of a Soviet missile attack.
- Increased funding of the Soviet space booster program after a year of denying and minimizing indications over whether this program was vital and over which agency should develop the rocket cluster.
- Increased Polaris missile-launching submarine programs, when congressional pressure has added two-thirds of the present program size to the original budget request.

Another major crack in the Administration defense policy has come from increasing evidence that the channels through which defense information flows to the White House often deliver incomplete, distorted and inadequate facts to the command-in-chief. It is evident that the intelligence data on which the President and his chief military intelligence, Defense Secretary Thomas Gates and Gen. Nathan Twining, chairman of the Joint Chiefs of Staff—are basing their position, dif-

fers considerably from the data presented to the Senate by Allen Dulles, head of the Central Intelligence Agency, concerning the Soviet missile thrust.

Although the President is, in effect, the direct commander-in-chief of Strategic Air Command and has some pronounced views on the operation of SAC, he has, as far as we have been able to determine, talked directly with the present SAC commander only once in the three years he has held this vital post. It must be somewhat of a shock to the American public which still has great faith in the President's military capability to find that he has not paid his first visit to the Cape Canaveral Missile Test Center during his seven years as President. He apparently spent about as much time appointing the top institution as it usually takes for a 15-hour round of golf.

The numerous technical inaccuracies that appeared in his two post-Sputnik television speeches on defense, the incredible episode of Texas Governor's 10-minute attempt to brief him on the ICBM development program several years ago and the Turkish order (recently all records) for his indications that the flow of current defense information to the President leaves considerable to be desired. Another indication of the gravity of the defense issue is the Administration's desperate attempts to defend its own position by discrediting the character and impugning the motives of any who dare to criticize it.

Assistant Defense Secretary Morris Ogilby, who functions as an appendage of White House Press Secretary James Hagerty, has been quoted by Life magazine and Drew Pearson, without any public denial, as ordering defense officials to "kick in the teeth" of reporters who question Administration defense policies and to impugn their patriotism. Gen. Twining, in a statement that would be unbelievable if it were not part of the printed record of Senate hearings, accused defense critics of being defeatists who "would like to see the end of the world." It must be obvious to Gen. Twining that defense critics want more effective defense, not less, and are urging this country to improve its position vis-à-vis the Soviet Union—not lay down and open the door to domination. This statement of Gen. Twining's must cast serious doubts on the validity of any other testimony he may provide as this crucial issue.

The basic issues involved in this defense debate are simple and clear, despite the obfuscation aimed at minimizing them. They are:

First, are we utilizing the full technical, industrial, military and economic capacity of this country to attain a military posture of unquestionable and undebatable superiority that will enable us to continue to provide world leadership? To this we negatively conclude the answer is "No."

Second, are we organizing our defense program around the basic requirements for continued survival as a free nation in the face of the Communist challenge to our way of organizing a second military giant leader? Again the answer appears to be a sad "No." And Defense Secretary Gates asks the question: The American people should continue to ask their leaders and those who appear to be leadership.

—Robert Holz

\* Διαφέρομεν δὲ καὶ ταῖς τῶν πολεμικῶν μελέταις τῶν ἑναντίων τοῖσιδε. Τὴν περὶ πόλιν κοινὴν παρέχομεν καὶ οὐκ ἔστιν ὅτε ξηλιασθῶσι ἀπείρουμένονα ἢ μὴ μαθήματος ἢ θαλάσσης, ὅ μὴ κρυφθῇεν ἂν εἰς τῶν πολεμίων ἰδῶν ὑφ'ἐλπίδος, πιστεύοντες οὐ ταῖς παρσκευαῖς τὸ πλέον καὶ ἀπάταις ἢ τῷ ὄψ' ἡμῶν αὐτῶν εἰς τὰ ἔργα εὐνύχῃ.

## THUCYDIDES

\* "We feel superior to our enemies in the art of war for these reasons: We throw open our city to all, and we never drive any stranger away to prevent him from learning or seeing anything; we conceal nothing, even though the knowledge of it may aid our foes; for we do not trust in preparations and crafty devices as much as to our natural courage in the hours of danger!"



Present conditions no longer permit a situation quite so ideal as Thucydides' "open city" as a realistic basis for national security. Work in basic research, however, is relatively free from the restrictions that are necessary for security in other areas. Basic research at the Physical Research Laboratory of Space Technology Laboratories, Inc., is conducted in an academic atmosphere which takes full account of the fact that free communication is essential to the development of science.

STL's Physical Research Laboratory is engaged in frontier research in the physical sciences, as applicable to ballistic missile and space vehicle systems, and to space technology generally. Analytical and experimental investigations of particular interest are fundamental studies in the fields of magnetohydrodynamics, plasma physics and low temperature solid state physics.

Members of STL's Senior Staff will be attending the annual meeting of the American Physical Society, New Yorker Hotel, New York City, January 27-31, 1969. They will be available for local interviews for those who are interested in openings now available at STL.

For an appointment please call Mr. T. W. Grossinger at the STL main, Hotel New Yorker, LQ-Openers 3-6538 or send resume and references to:



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## WHO'S WHERE

### In the Front Office

**Monroe Littlejohn**, a vice president Eastern Air Lines, Inc., in charge of the establishment of a new department of aerial film and planning.

**John T. Ryan**, a director, Elster-Ray Nat. Corporation of America, Union, N. J. Mr. Ryan is president of Colony Chemical Co.

**Dr. John A. Wilson**, a director, Washington Air Radio Co., Pittsburgh, Pa. Dr. Wilson is president of Pennsylvania State University and also is vice chairman of the President's Committee for Scientists and Engineers.

**Francis H. Brown**, president, Del-Ten America, Inc., North Dallas, Tex.

**Thomas R. Enright, Jr.**, vice president, Air Center Service Corp., Washington, D. C., a subsidiary of California State Airlines, Inc.

**G. B. Clark**, corporate vice president in charge of government affairs, Bell Aircraft Corp., Buffalo, N. Y., and James N. Davis, vice president/program manager, Bell's Napier Propeller Operations. Mr. Clark is also vice president of Bell Helicopter Corp., Fort Worth, Tex.

**William B. Davis**, vice president, aircraft maintenance and service operations, American Airlines, Inc. Also William H. Miller, vice president, Var, a new self-appointing, sales and service, and also in charge of American's European sales operations.

**Gene F. Bering**, vice president, marketing, Defense and Industrial Group, Ford Bell Electronics Corp., Los Angeles, Calif.

**Thomas M. Miller**, vice president traffic and sales, Delta Air Lines, Inc.

**Dr. James A. Marsh**, corporate vice president of engineering, Electronic Specialty Co., Los Angeles, Calif.

**Capt. Charles Stein, Jr.**, U.S.N., and vice president in charge of management research, United Research, Inc., Cambridge, Mass.

**James R. Culbreth**, a vice president, Management Associates Inc., Washington, Mass. Culbreth continues as manager of the Semiconductor Division.

**Mark Krenn**, vice president, systems strategy planning, Continental Air Lines.

**Mr. Glen J. R. Madson**, U.S.A.'s head chairman of Electronic Testing Laboratories, Washington, D. C.

**Dr. Nicholas Z. Gelboin**, deputy to the assistant administrator, General Services Administration and Space Administration, Washington.

### Honors and Elections

**Elmer W. Davis**, a director of Lockheed Aircraft Corp.'s Georgia Division, has been elected chairman of Dr. Enrico S. Pont's Traffic Controller Association Indian Air, according to H. R. Kane of its Atlanta Division or General Motors Corp. Also William E. Humphrey, traffic manager of Kansas Aircraft Corp., has been elected chairman of AIA's Traffic Control Rate and Classification Subcommittee, including L. C. Schuster of Thompson Radio, Woodbridge, Inc.

(Continued on page 155)

## INDUSTRY OBSERVER

**Navy** is studying plans for a single-pass photographic reconnaissance satellite that could be launched at sea, programmed to pass over a protected point on the earth and then recovered at sea after its aerial orbit. Designation of the study is Project Ye-Yo.

**Navy-Advanced Research Projects Agency's Transit III** Three-Mile star navigation satellite is now technically scheduled for a mid-April launch. Payload is being supplied by the Johns Hopkins Applied Physics Laboratory, with systems, systems engineering and systems engineering and technical direction being supplied by Space Technology Laboratories, Inc.

**Color-contrast method of comparing astronomical images on fluorescent negatives** has been developed by a Soviet scientist to help distinguish astronomical bodies from known ones. Known bodies appear black on negatives, new bodies appear red or blue. A color-contrast method using film and color comparison techniques has been used to study a new small planet discovered in the constellation Cassiopeia in 1957 by the Krasny Institute of Astrophysics' observatory in the foothills of the Tianshan mountains near Alma-Ata.

**Cassini's San Diego Synoptic Cassini** ballistic satellite state test site is scheduled to be expanded to keep pace with requirements anticipated for future programs of the National Aeronautics and Space Administration and Air Force.

**Kancon Aircraft** is entering its H-438 in the competition for an Indian government order for helicopters, bringing the total number of competitors to six. A Kancon sales representative is scheduled to visit New Delhi, Manila, Taipei and Tokyo. An H-438 also may be shipped to these points. Initial purpose of the Indian order is for high altitude supply operations in the Himalayas near the border of Communist China. Subsidized mail delivery (10-15 kilograms) is expected at first, but some suppliers believe the ultimate purchase could run in high as several hundred aircraft. Inertia sales with the Sikorski S-61 in the leading contender—expected within the next few weeks. Bids order will be made after evaluation of Westland Wessex, Aerospatiale F-751, Sud Alouette, Bell 204 Inquest and H-433.

**Western Electric** will use company funds to contract mechanical production facilities for the all-weather 2N559 nose-mounted antenna, a unit of which will be needed for Army's Nike Zeus anti-missile satellite gun into production. Company decision is based upon its belief that the 2N559 will find a number of other military and civil uses should the Defense Department stand by its original decision to withhold Zeus production funds (AW Nov. 28, p. 74).

**Initial delivery order for Lockheed's F-104C Super Starfighter** is expected to be for 10 aircraft, with a possible order for another 50. Original estimates of the order have been scaled down because of budgetary limitations.

**Navy** is launching a direct reconnaissance study in an effort to improve its anti-submarine warfare capabilities. Basic information will be collected on currents, wave frequencies, bottom features and ocean life. To expedite the program, designated T-100, Navy is making for a specially designed reconnaissance aircraft ship in its Fiscal 1961 budget request.

**New astronomical observation** located at 4,550 ft. above sea level near the Andean Indian town of Sarmiento in Ecuador has begun operation. Three telescopes have been installed, and the Karl Jansky optical works in San Juan de los Rios is waiting on a \$5-ft. diameter mirror for new telescope, which will be one of the largest in Europe. Radioastronomy techniques also will be employed.

**Plans to equip the nuclear carrier Enterprise**, now under construction, with Comair Terrier surface-to-air missiles have been accepted by Navy in an earlier move.



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## Washington Roundup

Defense came into sharp focus in a political issue last week. There are definite signs that key Democrats are leaning on selling in the electoral street issue by such presidential hopefuls as Sen. Lyndon Johnson (D-Tex.) and Sen. Stuart Symington (D-Mo.). And there also are signs that the Republicans are becoming deeply involved over the defense issue in the election year.

Confusion reigned on Capitol Hill as the military experts argued their cases. Chief of Naval Operations Adm. Arleigh Burke said he will ask for another \$971 million next year to build an additional six Polaris submarines. As Fleet Chief of Staff Gen. Thomas D. White depicted Navy plans of Polaris modernization and reported Strategic Air Command's plan for a B-57 airborne alert. Army Chief of Staff Gen. L. L. Lemmon said money for an airborne alert unit would not be used for a force of mobile Jupiter ICBMs and for more money for Nike Zeus. Joint Chiefs of Staff Chairman Gen. Nathan T. Twining defended the Administration budget down the line.

### Dispute Over Gap

Dispute over the gap between U. S. and Soviet missile capability is a major factor in the defense controversy. Dispute hinges on intelligence estimates of Soviet missile capability, and Sen. Symington made a move last week to encourage to reveal certain intelligence data which would make the extent of the missile gap clear. Central Intelligence Agency Chief Allen Dulles was called for a report performance before the Senate Space and Propulsion Committee to set the intelligence record straight.

While the battle flared in the Senate, key Democratic House members signed themselves with their party's defense stand. House Appropriations Committee Chairman Clement Cannon (D-Mo.) a vigorous fighter for more money, and U. S. military capability is lagging. Significantly, Cannon and the situation must be corrected during the current session of Congress.

House Armed Services Committee Chairman Carl Albert (D-Mont.) added his support to defense critics. He expressed criticism in such programs as the B-71 and called for a stable military posture dictated by military rather than fiscal needs. Vance's stand was publicly supported by House Speaker Sam Rayburn (D-Tex.).

### Conavert Trip

Republican criticism over the issue was shown by President Eisenhower's such trip to Cape Canaveral last week. As the President associated himself more closely with the space and missile effort, Republicans were conducting a local counterattack against their critics. This forced the project of a defense gap, passed U. S. Congress with missiles and space activities and were accused to some extent of the U. S. military position of a lack of political.

Conavert was considered by the Republicans defense critics as a way to promote its first trip to Cape Canaveral. It depicted efforts of opposition of a weapon system to promote it through publicity. He also denied that the national budget is dictated solely by local policy.

A bigger defense budget from Congress some scientific in Democratic power holds the improvement of the U. S. military position. The pressure was also pushing more money for space programs. Democrats criticized the defense budget will have to act through their control of Congress to back their stand. This means a bigger budget. This Administration cannot be forced to spend the extra money appropriated, but any further evidence of Soviet strength appearing before the defense will make the Administration politically vulnerable if it has accepted defense money in the bank.

Just Congressional Committee on Atomic Energy will investigate the Project Rover nuclear rocket program this week. Committee Chairman Sen. Charles F. McNamara (D-N. M.), has added language on the program to make sure it has enough money to spend at a fast pace. McNamara expressed fear that Project Rover might be moving into the field of lagging space generally associated with the atomic nuclear program program.

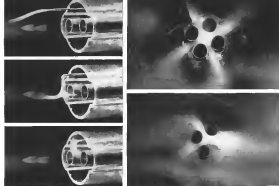
### Wrapup

Department of Defense is making revision of the definition of "selling" (AW Jan. 24, p. 26) to include the whole process of proposing, developing and producing a system, no expense spared by Rep. Edward R. Roybal (D-Cal.). Joint Economic Committee is looking into the activities of former defense and service contractors and has asked Defense Department for a list of all former contractors now employed by firms doing business with Defense. General Accounting Office is working on investigation of Defense Department procurement of electronic supplies and equipment to see if a system for measurement in deployment and in distribution whether a single agency should do the job. House resolution last week approved the transfer of Army Ballistic Missile Agency's Development Operations Division to National Aeronautics and Space Administration.

—Washington Staff

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**REVERSE FLOW** (left) is demonstrated by high pressure jet flow pastulating hot rocket exhaust. Tumbling probe rocket nozzles blowing downstream, in extended probe is extended (right) with nozzle going up and downstream, smoke it shows back at probe ball's attack. Smoke is reflected at coasts of bow (right). High pressure jets moving from all four nozzles (right) result in high bow heating. When one jet is that down (bottom) smoke released at base no longer is trapped and heating becomes much lower.

## AEDC Accelerates Ground Rocket Tests

Tullahoma, Tenn.—Growth in increased emphasis on ground testing of rocket engines under altitude conditions was stressed in the first U.S. symposium on the subject held here recently, less than two years after the first significant work in this area was begun.

The symposium at the Arnold Engineering Development Center was sponsored jointly by AEDC, Inc., operating contractor for AEDC, and Space Technology Laboratories, Inc. Twenty-two technical reports were presented by representatives of military organizations, industrial firms, NASA and the two sponsoring companies.

Main points made at the symposium: **• Exhaust flow** flow behind a nozzle powered with a clustered rocket engine. Rocket nozzles clustered with a double space in the center cause reverse flow of hot gases back toward the base of the nozzle. Reversing flow not only heats the nozzle base but it forces hot gas past the rocket engine nozzles at high pressures into the airflow surrounding the nozzle. These reverse high pressure gas streams have great unstable under certain conditions and have caused the thrust vector of the cluster to fluctuate rapidly. This type flow problem has occurred at all altitudes.

**• Improper location** of the mainline gas turbine exhaust pipes on large ballistic missiles resulted in the cancellation of fuel-rich exhaust nozzles back behind the nozzle. The missile base acted as a flame holder at low and medium altitudes in that external combustion of the fuel-rich exhaust occurred against the nozzle base, causing structural overheating and separation on some nozzles, nozzle failure. At high altitudes, this problem does not occur because the external air stream does not have enough oxygen to support the combustion of the turbine exhaust. Use of a long exhaust pipe to take the gases away from the nozzle base proved to be an adequate fix for this problem.

**• Bell Helicopter liquid fuel engine** proved to be reliable during most altitude chamber testing at AEDC, but those tests also revealed that the engine had poor altitude start characteristics after a prolonged period of engine in space. The engine's altitude ignition capability approached a level where the poststart temperatures dropped from 100% to 75%. One of the four fused for fire condition was to stop preheating the combustion chamber by compression of the oxidizer. These Bell engine tests in March 1975 were the first to be

conducted at AEDC on engines with thrust greater than 2,000 lb.

**• Third stage engine** for the Titan II launch probe was the first full-scale solid propellant engine to be tested at AEDC. Primary objective of tests in June, 1975, were to determine the total impulse of the engine through the full tank envelope. Tests showed that the predicted total impulse was in serious error. Other solid fuel engine problems detected were inadequate altitude heating, are charring or unprogrammed burning after engine shutdown, inaccurate heat transfer data for most nozzle configurations at altitude and nozzle cross by solid oxidizer particles, such as aluminum, at altitude.

Other solid fuel engine problems detected were inadequate altitude heating, are charring or unprogrammed burning after engine shutdown, inaccurate heat transfer data for most nozzle configurations at altitude and nozzle cross by solid oxidizer particles, such as aluminum, at altitude. Solid rocket products also caused flow separation in the nozzle and resultant performance reductions before serious failures began.

Timed tests of unaltered altitude testing of all the engines tested by AEDC is believed to be much greater than those accomplished by any other U.S. facility. Full scale and model rocket engines with thrusts up to 60,000 lb and burning times up to five minutes have been fired a total of 540 times at simulated altitudes of 100,000 ft and above. Approximately 310 of these have been solid fuel firings, 430 liquid fuel firings.

## Soviets Study Moon 'Transit Stations'

Washington—Soviet rocket program new rules it possible to put into orbit satellites that will weigh several tons and will serve eventually as "transit stations" for manned flights to the moon and planets, Russian scientists said.

Recent Soviet references to these large, earth-orbiting satellites make them sound as if they might be launching bases for interplanetary rockets rather than merely necessary, experimental steps that precede launching of manned rockets directly from the earth.

For the first time, the new "space powerful" ballistic rocket assembly, fired by Russia in Russia tests (AV Feb. 1, p. 15), has been referred to by a Russian newspaper as a "ballistic missile" and by the official Communist Chinese news agency as "the Soviet multistage ballistic missile."

All official newspaper reports of the test leaps through the Russian news agency (the Red Star) Moscow have called the vehicle a "rocket," making no reference to missiles.

China this episode of "intercontinental ballistic missiles" in connection with the test and said. The role of the missile carrier in the test is one of the most important questions to be asked in the track of KGBM and in the study of human flight into cosmic space.

G. G. Kazantsev, a Kurchatov Institute of Atomic Energy professor of physics, pointed out that the rocket entered in the Pacific beyond a distance "equal to one quarter of the earth's circumference along the equator" and "looked over one state that there is now no power on the surface, sea or land, that cannot be reached by rockets."

Nikolai Voronov, described by Tass as "an authority on astronautics" wrote in Komsomolskaya Pravda that progress in rockets, rocket engines and guidance systems "already makes it possible to send Sputnik several times at night." This will permit the orbiting of tide stops, radio telescopes and the return of photographs to earth by returning cosmonauts or by television, he said.

Large Sputnik also "opens up great prospects for solving the problem of world-wide 'monitoring' and after the possibility of intercontinental communications, circling the earth 'in 3 to 2 hr,'" Voronov said.

Kazantsev said it will be possible "in the not distant future to create a big, powerful, orbiting earth 'Sputnik' which will serve as a large scientific laboratory to conduct research into various types of cosmic radiation and study the effect of space flight on the human organism."

"Especially, this Sputnik will serve

as a unique kind of transit station for human flights to the moon and other planets of the solar system."

Two other Soviet scientists wrote of heavy earth satellites in connection with the Soviet tests and said heavy satellites are necessary steps toward space ships. Only one of them, Prof. Ya. Fabel'denskiy of the USSR Academy of Sciences' space commission, spoke of the orbiting station as if it were to be a launch base.

In an article in Zvezdochka, Zvezda, Fabel'denskiy noted that a space plane from orbiting the earth must be set up for launching rockets to other planets."

Prof. Georgiy Fedorov, also a member of the space commission, said the

recent test flights tested an "automatic guidance system" developed in the USSR, and proved an "exceptional dependability and accuracy." The rocket system, it is charged, dependable and stable, "Palmovskiy said."

The Chinese article which called the modern "intercontinental ballistic missile" and Soviet scientists have "avoided many means to launch space ships" in the past, including installing a "ballistic jet engine" on the "control" and "steering" two wings on the "nozzle" and "directing" the missile flight into the atmosphere and toward the earth, set at a special angle, but of a special angle so that it will gradually reduce its speed and land in the same way as an aircraft.

## Titan Test Silos Under Construction

Yonkersburg, AFB, Calif.—Construction of two launch test bolls (SLTF), in which the four-stage Titan ICBM will be tested for firing from bottom of the silo will soon be begun.

SLTF is in addition to operational readiness test facility (ORTF) and testing facilities (TFI) both of which are expected to be operating late this year (AV Jan. 14, p. 37). ORTF and TFI both provide for Titan to be lifted to the surface by an elevator for engine ignition and launch.

Silo bottom launch is last step of Titan improvement program. Test site is needed, but there is no provision beyond this for operational use of this type launch. One phase of Titan improvement known to be funded is second guidance system built by AC Spark Plug involving two Minuteman's Institute of Technology design, which will replace current radio-command guidance. Early when this second system will enter operational use it is uncertain.

It is expected that TFI and TFI Titan testing facilities complex, which also will be built here, will incorporate improved Titan guidance, perhaps even a third guidance system.

There have been no full-scale Titan engine firings as a silo launch test, although there are two large test bolls of two Titan ICBM test silos. One of the two Titan ICBM test silos, used at 100,000 ft, about, is a silo to a smaller structure.

Among other things SLTF will test ways of removing liquid propellant rocket engine exhaust gas. Possible risks, allowing gas to flow directly up around the nozzle, are being tested and it has been to be a major problem would also occur in the air, as through a U-shaped nozzle when gas is forced into the silo and the curved bottom and opposite vertical walls are gas exhaust passage.

Test site also will be used to investigate ways to dispose of the tremendous amount of acoustic energy the rocket engines will generate during three launch and static tests.

When operational tests are tested by TFI through TFI, such tests incorporating one specimen of one missile engine for T-1 at Launch AFB, Davis, Calif., when two specimens will be tested. Tests on configurations will be highly similar, if not identical, to those in AFB program, where four engines were operated during the first operational test as major improvements are incorporated one at a time rather than in a group.

It is anticipated TFI TFI and subsequent tests through the TFI test specimens authorized by the Martin Company would use silo launch, but although they are prepared, construction has not begun on these test bolls. The TFI test bolls also must be built by the joint in the Titan program, where the missile would be tested, operational, incorporating a propellant system.

Cost of both Titan silos ranges from \$50 million to \$100 million each, depending on whether the displacement has one central outlet for every four launch silo in a complex or one central outlet for each silo in the entire complex. The latter approach would almost surely have the ICBM fired from the silo launch reducing to a few months the time during which the base would be "idle" (only the silo left) during launch.



## ARDC Plans Index of Industry Skills

By Philip J. Klass

Washington—An Research and Development Command plans to draft a register of 30,000-to-50,000 scientists and engineers working in all fields of technology to permit fast access to experts in any given field and reduce duplication of scientific effort.

The program, known as Project Cost for Current ARDC Technical Efforts, is scheduled to get under way within the next several weeks.

Beginning Mar. 3, Air Force contractors and subcontractors will be asked to keep their engineers and scientists filled out small cards to show, which of 31 different technical fields in which they are currently working, with a more detailed breakdown into one or more subareas and additional key words to describe the specific nature of that individual's work.

The information assembled by ARIUM will be reduced to punched card form and be sent in three two hour

• **Tactical motion**, one of each of the 3 tactical faults, which occurs in a variety of circumstances. Tactical motion is defined as that action together with key words that describe how participants spend their time to address and telephone number, name, address, and the name of the person who is the subject of the search. Each of these Air Force accounts in turn will have a complete, complete tactical motion with a list of all registered accounts and a list of all registered accounts and their locations. If an individual cannot or cannot make tactical motion, an account, or wishes to find out who is in the account, they can find out who is in the account by looking through the list of all Air Force accounts and find the name who spends most of the time in the Air Force accounts. This is the tactical motion. This knowledge that allows the industry to create records, the Air Force industry can refer to to complete Air Force industry records to complete other accounts and to complete other accounts.

\* IBM 9110 computer and a small staff at Air Force Research Division's Project Cure office will be available for consultation and machine-search of its extensive punched card register for hard-to-find data. Inquiries can be made by telephone or by letter.

Project Gate already has undergone several months of trial operation, using a register of about 1,000 Air Force engineers and mechanics, with numbers

rection, according to Lt. Col James Viana, ARDC, who heads the program. Approximately 600 industry requests have been received and processed at CofS headquarters, with an average of less than 20 min being required to issue the appropriate USAF instruction.

The decision to publish notices of USAT vacancies and three areas of specialty for distribution to industry is expected to greatly accelerate the process by enabling industry to go directly to the Air Force specialist without working through Cote headquarters for review requests.

At present, the 13 major technological fields each averaged a code number from 0169 to 3906; methods advanced weapons, bioelectronic research, communications, computer techniques, identification, defense techniques, electro-sensory instruments, electronic systems, electromagnetic warfare, electronics research, electronic techniques, flight control, light mechanisms, graphics, geophysical research, human performance, intelligence techniques, materials, medical research, mechanical research, microfilm and products, modern optics, navigation, nonlethal weapons.

### Cesana-Holste Deal

From Among Miss Hildes, Kewen, Finney, and George Ascroft are discussing exchange of inmate rights. Cassin reportedly is interested in reuniting and U.S. with rights of Miss Hildes' brother-in-law, the M11230 Super Inmate (JW 18, p. 57). Tom Inmate, 71 prisoner, is slated to make his first flight this spring. Hildes, in turn, would acquire similar rights to Cassin, possibly for West Europe.

In another transaction, Cressa shortly will begin negotiations with Fiter-Air Fomg on ordering 400 of the French company's new 185 hp four-cylinder en-

Polar engine is interleafgrade with the Castrolmodel D90. Polar has built 10 prototypes of the engine and recently had it certified at 191 hp. Originally, the engine was created at 90 hp at 2,500 rpm. Maximum cranking power is 60 hp at 2,325 rpm. (AW Feb. 6, p. 107)

Fiat will market both the 80 hp version and the 105 hp version. Part of the Fiat engine is not yet set, although it is likely to be around \$1,600 F1B. On its possible order for 400, General Motors said Fiat's offer could be filled at a rate of 40 engines monthly. Henry Fiat told Reuters: Work is expected to begin production once the engine start fall at a rate of 50 per month.

protection and restoration of personnel; reconnaissance; secondary power; repair equipment techniques; surveillance techniques; vehicle defense; weapons in control; hypothetical various scenarios; synthesis and analysis; resource survey; political and social science in marine the course.

Under each of these 35 headings there may be up to 25 subheadings each with a code number.

## Indicate Code Number

Each engineer and technical entry in the ARDC Code system will indicate by code number his primary effort and his secondary area of effort. Then he will write a maximum of six words which best describe the nature of his current work.

For example, one Air Force scientist at Cambridge Research Center by code number 1906 is his primary contact A reference to the Project C

'vocabulary handbook,' indicates the three goals with experimental and theoretical techniques for graphical research. Then, under descriptive words that scientists have inferred, spectra, shape, education, phenomena, close and dispersion. For related effect categories, statistical based number 138 (lower strength) and later the

lowing descriptive words: bedigious, infrared, stranglethorn, transimposed, waltzes and oozes.

These descriptive words are subsequently coded and used by Project Cat office when attempting to locate a specialist in an unusual field, or with a unusual combination of talents.

The Project Core vocabulary book lists about 2,700 descriptive words that have been developed by participants, research and actual experience during the program's trial run. ARDQ, however, does not insist that a given participant use one of these to describe his work. Instead, it plans to add to the existing vocabulary as scientists use new words to describe their efforts.

Beginning next month, Col. Vane and other Project Cate personnel will hold seminars in New York, Boston, Philadelphia, Washington, Chicago, Los Angeles, San Francisco and other major cities to brief industry on the program's objectives. ARDC also has prepared 900 copies of a manual describing the operation of the program.

ARDC will exchange industry to report on company-sponsored projects which may be considered proprietary with the assurance that such information will be used solely for Air Force purposes and will not be released to other companies, if competitive advantage is desired, according to Col. Vane.

Col Voss says that ARDC hopes to have at least 90% of its missions, and back to early concepts, with 10% by the end of the year. Project Catalyst began as an ARDC headquarters program, was recently transferred to the newly formed Air Force Research Division. Ideas for Project Catalyst include: to Brig Gen B. G. Holloman, an AFRL commander, and Maj. Gen. Martin Dwyer, USAF director of research and development.

Companies seeking additional information on Project Cate may write to Lt. Col James Vane, AFMD, Project Cate, Andrews AFB, Washington 20334, D. C.

## Swiss Team Inspects Raytheon Hawk Missile

Gene-bank at three times is using the United States to study the Rhesus B-cell mouse and its possible adaptation for defense against low virus levels.

State military critics requested the through channels, but received only a rough, unclassified sales brochure from Raytheon. Now the air force has made an official request to Northrup Corp. for presentation but presumably the company has to get clearance to suit a presentation anywhere above a completely unclassified level.

## Pershing Test Pads Readied at Canaveral

**Cape Canaveral, Fla.**—Contractors of the \$2.46-million landing complex for the Anne Murray Peckham mission (see p. 12) is virtually complete and construction of two blockhouses, two ground-level landing pads and two air launchers for the Air Force SM-64 Minuteman will be finished.

Lunch complex for the NAS Seters space school is due for completion early next year. So far, \$11,985,000 in construction contracts has been awarded. Seters will use a 303-ft long serving two lunching pads.

Lower complex 5B, which has been designated the Space Services Complex, is expected to be completed by next year. It will be used for flights of the Conquest Atlas-Coyote for both USA and the National Aeronautics and Space Administration. This complex was constructed by the NASA Conquest Vega space shuttle before that project was cancelled last December. The General Landlord Atlas Agena, which will carry out most of the Vega mission, will be built from one of the four original Atlas pads. It will be used by both USAF and NASA.

Two modified sites for banding on the USAF Marine Corps base (near) are to be completed this spring, and the Comair Aeris II impact (positive) site is being given a final check-out. It is expected to be operational within the next few months and will be able to determine the position of a mine within one-tenth of a foot at a distance of several hundred miles.

Minuteman blockhouses will be built in a cluster with four-foot walls. A total of 56,000,000 in concrete (two months) has been awarded.

<sup>a</sup>Silens<sup>†</sup> Satellite

Washington. — Underestimated "solent" satellite traveling in an elliptical, near-polar orbit has been tracked for "some time" by U.S. agency surveillance stations. Defense Department said last week it "may be of Soviet origin."

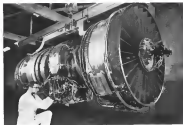
Initial theory was that the object, which is slightly smaller than the 1978 annual stage of the U. S. Space Shuttle and could be a detectable reentry, might be a stage of the Soviet vehicle that launched the latest photographic satellite. Defense officials later work said privately, however, that it is "premature to conclude definitely what the source of this is."

Other factors are that it is a Soviet reconnaissance satellite that cannot only save Russia, or that it is a Soviet satellite that was partially untrustworthy and, therefore, not insured by Russia.



### Parshing Service Tower at Cape Canaveral

Feeling suite more than 100 ft. is almost completed. Complex comprises a two-story mid-rise with 2 ft. thick concrete-slab roof, two launch pads with service towers, missile installation and checkout building, and helicopter parking apron. The federal range missile is being developed by North Co. for Army.



P&W JT3Ds for Boeing B-52H

For Jet Pratt & Whitney JT3D includes engines for use on the Boeing B-52H nuclear bomber (AW Feb. 8, p. 37) have scored at Boeing Airplane Co.'s Wichita Division plant. Military engineers will be T-37, rated at 36,000 lb. and specific fuel consumption is 41. The engine is based on the JT3.

## NASA Asks Hydrogen Engine Bid

Washington—National Aeronautics and Space Administration will formally ask for bids this week on its new 300,000 lb. thrust liquid hydrogen liquid oxygen engine, and the agency expects to choose a contractor within three months.

Formal request for bids follows a technical briefing of more interested companies (AW Feb. 8, p. 25), and the bids will be due Mar. 14. Evaluation of the bids is expected to be completed by early May, and NASA will then choose a contractor to develop the engine.

Hydrogen engine development programs will have to meet a schedule call for preliminary flight testing that begins in 1975. Although the overall potential of the engine is to be 300,000 lb. thrust, it will be operated only in inert at 165,000 lb. thrust within that time period.

### Single Chamber

This hydrogen engine, which will be used in upper stages of advanced Saturn vehicles, will be a single chamber engine which can be used singly or clustered in groups of two and four. NASA has set diameter limits on the engine, but there is no limit on length. It must be designed for use installation of a standard system.

NASA stressed reliability in its technical briefing, and companies have been told to hold to a minimum any requests for financial support of new facilities for the engine program. The contractor

will be required to conduct simulated high altitude tests of the engine in a government facility. Arnold Engineering Development Center would serve the most likely site for such testing.

The hydrogen engine development program is slated for \$14 million in fiscal 1961, plus six more NASA civil engine vehicles from its fiscal 1962 budget. Since a contractor will not be chosen until the current fiscal year is over, or, funding problems shouldn't be serious.

### Second Stage

Hydrogen engine will be used in the C-2 and C-3 versions of the Saturn vehicle. Earlier C-1 version will use a modified Centaur vehicle with two Pratt & Whitney XLR-115, 15,000 lb. thrust liquid hydrogen engines in a third stage. Second stage will be powered by two C-2 engines. The C-2 engine will develop 20,000 lb. NASA is expected to choose a contractor for this second stage about April 1.

Discussing the various versions of the Saturn vehicle, Wendell von Rosen, director of Ames Ballistic Missile Agency's Development Operations Division, has said the C-1 vehicle will be able to put a payload weighing from 23,000 to 35,000 lb. into orbit, with payload weight depending on the altitude of the orbit. He expects the C-2 Saturn vehicle to be able to put 45,000 lb. into orbit, and two men around the moon as launch orbit equipment for a Mars or Venus landing.

## Nose Cone Separation Halts Titan Test Flight

Washington—Air Force Martin Marietta Titan test vehicle C-4 disintegrated in flight Feb. 5 after the experimental nose cone tore off and damaged both stages.

Although the exact cause of the premature nose cone separation is not known, disintegration between the cone and the second stage is being investigated in later studies as a precaution.

This was the first Titan test at which separation of the nose cone was to have been attempted. Recovery of a data capsule ejected from the nose also was to have been made. The Air Force was a scheduled, experimental nose, leaving the nose configuration as the cone on the Titan C-3, which exploded on its pad Dec. 22. All Titans in the G series will use similar cones.

The flight was the first launching from Pad 16 since it was damaged in the December explosion. The C-4 was the first Titan that has followed its static schedule since launch through static tests and to launching without a delay prior to launching or an abnormal shutdown of its first stage engines as an attempted launching. It would have been the second flight test of second stage ignition and propulsion.

A few problems did occur before the nose cone popped off, damaging the sides of both stages and leaving the front end of the second stage open to the atmosphere. Structural damage fire and explosion destroyed the C-4. The second stage broke apart and disintegrated in 15 seconds during its ascent, burning at both ends. Second stage engine was not automatically ignited and the safety-destruct system was not activated in the event.

Titan flew within the same work on its first preliminary test of second stage propulsion (AW Feb. 5, p. 38).

## Impact Locator Systems Developed by Bell Labs

New York—Bell Telephone Laboratories has developed two types of acoustic wave detection systems which locate the impact point of a ballistic missile nose cone when it hits the surface of the ocean, and they are now in operation at the Atlantic Missile Range and are being installed on the Pacific Missile Range.

One system, which detects impact point location from the noise created by impact, employs the hydrophones in a circular pattern around the impact and configuration with a depth receiver in the center. The network is also connected by submarine cable to three stations which monitor test data before receipt of impact signal at their

on state of the hydrophones. Second such installations are now in operation at the Atlantic, including also near American Island.

The second locating system makes use of a radio beam which is opened by the reentering vehicle and explodes under water near the impact point. A series of hydrophones, usually secured in pairs and spaced over a wide area with cable interconnections to shore stations, can obtain an accurate fix by measuring time delay in receipt of the sound of the explosion. Detection signals up to several thousand miles are possible. Systems were installed by Western Electric Co.

## GE Will Produce Marine Gas Turbines

General Electric, as a move to diversify its turbine engine product line, will produce gas turbines for marine and industrial applications.

Initial turbine models include a 20,000-shp. version of the T75, a 400-shp modification of the T35 and a 75-shp turbine supported from the BMTV nose, March, West Coast Center.

First application of General Electric's large turbine will be the main propulsion unit for Dynamic Development Corp.'s hydrofoil concept (AW Feb. 1, p. 42).

The engine, the Model 240, will be rated at 20,000 shp for a maximum of 5 min. and will have a continuous rating of 18,100 shp. The 5,900 lb. Model 240 is slated to be delivered to the Dynamic Development Corp., a Graziano subsidiary, by the end of the year. The engine is scheduled for the spring of 1962.

The 500-hp T35 derivative is designated the Model 725 (Model 722 is intended for inland gas turbine). The turbine also will be employed in the 50-ton hydrofoil craft. This structure powerplant will be used to compress the craft at low speeds when the displacement hull is in the water. It is currently in powering a 24-ft experimental hydrofoil craft.

Commercial applications for the Model 720/722 include powering a free-turbine pump in the petroleum industry and as a compressor drive on inland gas pipeline pumping station.

The BMW 6002 turbine engine will be supported by General Electric as approximately an month and, it is hoped, a usually popular low cost turbine. The engine is now rated at 73 hp, but General Electric expects to market the engine at power levels from 100 hp up to 200 hp.

The Model 6002 is 25 in. long and 15 in. in diameter; its weight is 133 lb. with gearbox.



C-130 Boundary Layer Tested

Lockheed NC-118B boundary layer control tested in its first flight last week at Edwards, Cal. Tested aircraft will be tested and then used for the boundary layer system under the nose of a bomber with its modified controls. The BLC will be tested at high altitude. If these tests are successful, the NC-118B will use the system on short takeoffs and landings. Production aircraft will use two modified A-105 testbeds to drive the BLC system. The production model will use nose control boundary engine. Aircraft was tested to Lockheed after the Air Force terminated financial support of the project, and the company will finish the program with its own funds.

## News Digest

Export-Import Bank has approved a loan of \$6.9 million to Vang, Business Airlines, to cover the major portion of the purchase of two Boeing 707 aircraft from Boeing Aircraft Co. for transport of mail and cargo.

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Japanese government is preparing to place orders with the U. S. for 12 Conquest Taurus guided missiles, two launchers and a firing control device to be installed on a new defense vessel of the Sea Self Defense Force. Missiles cost \$100,000 each. The round is scheduled to be launched in 1965.

Stanford University disclosed last week that it made first reported order contract with the Air Force April by becoming a 26-m. signal of the air's current using radio built for composite studies.

Japan Air Lines is sending a service from this month to Conquest Sea Diego plant to which the Conquest 1000 aircraft is expected for use on routes to Southeast Asia and to Hawaii. The air line is in the market for three other aircraft for delivery within 10 months. Japan Air Lines also is studying the Conquest 8, Conquest 8C, Boeing 720 and 720B and the Conquest 800/500.

## Joint Communications

Washington—Defense Department announced plans last week to establish a joint military long-range communications system through adaptation and expansion of existing services facilities, as provided by Air Force Work (Aug. 16, p. 28).

New joint communications network, as now planned, will not include major control and tactical communication system, such as Strategic Air Command and Air Defense Command control systems. Individual agencies have opened the plan for how they would like these important mission facilities. Joint system will be developed on an ad hoc basis over the next decade.

Edward J. Ryan, North American Aviation corporate director of public relations, died in Los Angeles earlier this month. Ryan, 52, joined North American in 1944 and became director of public relations in 1945. NAA News Bureau Manager William E. Van Dyle will succeed Ryan.

British Minister of Aviation Duncan Sandys and last week that Britain is seeking design modifications to further reduce its to be used as a space vehicle. This was the first official announcement that Britain plans to use its own launchers as well as those offered by the U. S. He undoubtedly had in mind the Delta II, Black Brant and Sandys' new Black Knight, probably in combination (AW Sept. 14, p. 108).

# New Plan May End Airline-MATS Fight

Defense program approved by President would reduce channel traffic, provide longer-term contracts.

By L. L. Doty

Washington—President Eisenhower last week approved a program calling for a series of Military Air Transport Service flights, if supplemented, could bring to an end the long drawn-out battle between airlines and MATS.

The program, which was contained in a study of MATS prepared for the President by the Defense Department (AW Jan. 18, p. 45), included these points, which historically have been the chief sources of contention:

- MATS' leased fleet, which is moved one foot north or south "induced on an ad-hoc basis, consistent with current airlift capabilities at reasonable cost."
- MATS will be equipped to meet military "hard-core" and other requirements that cannot be handled adequately by commercial airlines.
- Policies of pricing airlift from the commercial airlines to aviation operators have not been better adapted to long range. Defense Department requires "This includes contracts, in which large time contracts with carriers, including commercial participation to re-route traffic other than channel traffic and giving preference to those carriers which are committed to the Civil Air Reserve Force, whose facilities are used to deliver emergency needs and which show willingness to "acquire an emergency cargo aircraft."

The program calls for joint utilization of standard loading of the development of a uniform general cargo aircraft that will be compatible with the operation of each group. It also included a provision that reserved use of commercial carriers should be limited to the introduction of "flexible, commercial long-range aircraft" by the service and to the introduction of MATS to its "hard-core" facilities.

Since finding of an implementation of the program, MATS is the dual operator and operator of an all-cargo, turbine-powered aircraft, some due to as when the program may be in full swing is found in recent budget requests by the Air Force.

USAF is now asking for \$75 million for the development and design of "a high speed cargo aircraft" which, based on July 1 approval, will be placed into the first MATS operational stage next July 1, 1954. Second and third squadrons are scheduled to become operational during fiscal 1965.

Other points in the program approved by the President are:

- Modernization of MATS' hard-core

aircraft capability to be undertaken as an "ad-hoc measure consistent with" existing requirements. These requirements are defined as special military, developments including military requirements from Strategic Air Command, post-war aircraft, military, tactical, and other requirements of military and special operations.

- Positive law guarantee legislation, if proposed should contain provisions ensuring "immediate availability of cargo aircraft" to meet military and nonmilitary requirements.

- Expanding reserve and National Guard units with transports declared over in MATS to augment MATS in emergency should be considered.
- Civil Reserve Air Fleet role should be re-examined.

## Defense Study

The Defense Department study stated that the present type of operation (conducted by MATS in the "gross of the bulk of military" aircraft at MATS and added:

"The finding against the MATS as a type of operation has become a source of loss to us to constitute an of active block against the modernization of military airlift capability."

On this point, the study found that aircraft capacity assigned to MATS is adequate to meet the "hard-core" requirements of a general war but that that it is "seriously deficient qualitatively and greatly dependent on the availability of intermediate sized loads."

It used the C-119 as the only modern aircraft in MATS, with the remainder of the fleet consisting only of piston engine aircraft, and concluded:

"The casual cargo airlift situation is further and more acute in that to modernize and expand the national cargo capability, both military and commercial, efficient airlift support cannot be secured from sources. Further, active cargo capability is inadequate

and expanded, the Department of Defense and the nation will continue to be faced efficient and economical airlift."

Throughout the study, significant conclusions of commercial airlift were made. The study said that the amount of commercial airlift provided by MATS has increased from \$2.1 million in fiscal 1954 to \$29.4 million in fiscal 1959. Estimated expenditures in fiscal 1960 are expected to reach \$35 million.

The report said that, although MATS has a total of 1,345 aircraft assigned to it, only 511 are "in the element of strategic airlift fleet." The majority of the remainder, the study said, is not even "transport configured." It noted that the C-119, the "workhorse of the military fleet," is rapidly approaching obsolescence.

The study pointed out airlines can accommodate such a small percentage of military traffic that can be handled by air and added:

"But we are aware of the potential of military aircraft which are damaged in cargo service. All commercial cargo aircraft have the serious disadvantage of high turn and idle time loading. For many types of military cargo there are no alternatives. The proposed provision cargo capabilities."

The study reported that, while there are indications that commercial airlines are willing to undertake some modernization of cargo fleets based on the potential of the commercial air transport market, "there is a belief widely held within the government that a diversion of sizable quantities of government traffic might greatly accelerate this modernization."

On this point, it concluded that as sources of government traffic to the airlines would make the airlines as the planning and financing of re-equipment programs, and that the MATS is adequate to meet the "hard-core" requirements of a general war but that that it is "seriously deficient qualitatively and greatly dependent on the availability of intermediate sized loads."

In considering the transport program, Stuart C. Tipton, president of the Air Transport Association, said "The recommendations contained in the report are, if properly carried out, provide the airline with a much improved airlift."

Each airline reaction to the report was similarly favorable, although there was some doubt expressed as to a few airline officials here that the program would cover such the full requirements proposed in the study.



## National Takes Delivery of Its First DC-8

National Airlines has taken delivery of the first of three Douglas DC-8s. The 315-passenger jet transport will undergo acceptance checks at Miami and will be used for training flight and ground crew before entering service between New York and Miami.

## Douglas Will Sell and Service Caravelles

New York—Douglas Aircraft Co. has set in lot with the major jet carrier with a short-term commercial transport contract, making an important step in the production of the Douglas DC-8.

Sales prospects of the French jet (which Douglas last week at Douglas and Sud Aviation reached an agreement involving U.S. sales and service and possible production of the airplane (AW Jan. 31, p. 42).

The agreement mentioned here (which Douglas and Sud have "leased" instead of "purchased") in the Caravelle and Douglas DC-8, and the possible other long-range projects which companies may develop. Under the Caravelle agreement, Douglas will provide sales support, maintenance and parts support, and customer ground and flight training. Douglas also gets the right to manufacture the Caravelle, and will represent Sud in various territories throughout the world in "all matters affecting the Caravelle transport."

Partnering the Caravelle and DC-8 as a complementary combination, the two manufacturers will provide world-wide sales support for each other.

The agreement is believed to have been entered into the recent July 1 U.S. & Canada passport-United Air Lines—whose order of 20 with option for 10—was considered imminent. Sud last week would not comment officially on the United reports except to say that a sale will still under negotiation.

A spokesman said, however, that the aircraft was being built for United and if the contract isn't signed, this will be sold to someone else.

A previous meeting took place in the United States with the airline's statement that trade in of 20 passenger Douglas DC-8s and DC-7s be acquired in the deal (AW Jan. 6, p. 12). The consideration was how having had Caravelle for sale delivery and will not

be in Boeing, which also was discussing Caravelle plans with the French manufacturer.

United, on any other U.S. airline customer, may would agree with Douglas instead of Sud and this should simplify off-line service and similar contract agreements.

Donald Douglas, Jr., president of Douglas Aircraft, said here last week that the other aspect of the agreement—"cooperation in other future projects"—was important in the Caravelle agreement.

For a future program which could include product development, it is expected by his company to have access to the European common market according to Douglas. Sud is a strong position both in the common market and in the United States, Douglas said.

## Delivery Date

Regarding the Caravelle agreement, Douglas said his company could produce the jet transport for delivery within two years. But is offering the Caravelle with MA-100-Bullfinch-1000 turbojet engines (AW Dec. 21, p. 24), including flight screens for April, 1961. Production of the French factory is now at a rate of five planes a month.

If Douglas produces the Caravelle, growth modifications would be incorporated and a change of engine-Rolls Royce in a U.S. order—would be offered Douglas, which is now said to provide Sud with technical production and technical background the French manufacturer may want, will work with Sud on modification plans and will come up with modification of its own for French and/or American production.

Financesmen among U.S. airline manufacturers for a possible Caravelle (possibly) would appear to be General Electric. What company has ordered Caravelle for sale delivery and will not

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1961, the designers estimated Douglas estimated the U.S. market for the airplane at about 900 orders in the civil three- or four-year period possible, and to U.S. customers in financing Canadian purchases, Douglas and his company would study other cases, as it does with the DC-8, and would be satisfied with the results.

The Douglas official would not act as a minimum number of airplane orders his company would consider necessary to act up Canadian production. And of 10,000, the probable cost involved in a United order with options was a reasonable number, Douglas acknowledged "that would make the interesting, but indications were that 10 or 50 would be closer to the desired point."

#### Project Studies

Regarding declassification plans, Douglas said his company and Sud have common problems and would work together in developing other proposals. Douglas seemed to have stressed its study organization in this report, he said, and has undertaken broad research on the declassification issue. Thinking is for medium, rather than small, production sizes with options—10,000 or 50,000—would be to sell the entire organization, including looking at well as manufacturing. The agreement with Sud would not preclude other companies working with others in special contracts.

Heard said Sud's agreement with Republic Aviation for U.S. handling of the Alouette helicopter still stands, and that other possible helicopter projects also would come under the Republic agreement.

Sud's present four-month Canadian production rate was reached in December, five months ahead of schedule. Line 10, Canada, Sud managing director, said, "Canadian production rate could go to live in months without adding a production line. With a U.S. consultation during the week, the monthly total could go to seven, he said. The Canadian production rate is different between annual France, and at that, which builds about 8% of the aircraft. Some 60% of Sud's employees work in the U.S. And had increased in its rate of increase, where the daily work schedule is now 75 hr.

#### Future Plans

At the New York conference, Douglas mentioned other customer concerns, including the DC-8 and the DC-9. • **Cargo version of the DC-8** is being studied along with a total system study in the cargo field. Among the questions at its possible configuration of a cargo DC-8 is the potential declassification of the aircraft. The estimated limit was around 20,000 lb. That, but at now up to 24,000 lb. An all-cargo version of the Canadair, along

with "any possible configuration," will be studied in cooperation with Sud. • **Speed of the transcontinental DC-8** "is not as slow as advertised by all our friends." United, according to Douglas, now is averaging two minutes less time in competition in its jet schedules. Modifications and improvements now under way will contribute to the long-range wing program of the DC-8, and international customers have agreed to "some slight delay" in delivery. There has been some delay in increasing production in the long range, slower speed, but they are under way. • **Douglas is "spending more money"**

## Swing-Tail Turbofan Cargo Plane Proposed for MATS by Boeing

Washington—Boeing operating costs and improved performance capabilities in cargo operations on MATS. An Air Transport Service meeting during the introduction of a high-speed, large capacity cargo aircraft provided by Boeing for MATS. The aircraft has been studied in an economic study prepared by Boeing Aerospace Co.

The study, prepared by Prof. Stanley B. Borman of the University of Washington, includes a detailed economic comparison of the proposed Boeing turbofan aircraft with other aircraft currently operated by MATS. The aircraft, an all-cargo, swing-tail transport proposed by Prof. Borman and Whittier Field, includes engine, fuel, power, and other systems of the Boeing 747. The aircraft is a swing-tail transport.

Boeing outlined these features in its study: • **Turbofan cargo plane** now operates at a much lower rate than any cargo transport now in service. • **At load factors of 90% or above**, the turbofan aircraft makes more to overcome total operating costs over the current cargo transport, capable of 25 percent. Since the plane is designed as a long-range, long-range transport, economic advantages are not great at low load factors.

• **Major advantages** are reduction in fuel and installed equipment costs in order to achieve a given lift and a reduction in total cost for transporting cargo.

• **Unit costs will be increased** and revenue cargo capacity will be cut at a cargo shipment weight less than 12.5 lb. per cu ft. Plane is not designed to carry economically low cargo which occupies a large volume of space in proportion to weight. • **Lower costs** than the comparative study, since the C-119B, C-119C, C-119D, C-119E, C-119F and the C-119G. Economic factors involved in operating

on vertical takeoff and land aircraft. Such models have been built but not actual flights. • **Boeing's investment** in development of the aircraft depends on how much money goes into development, and practically nothing is now being spent in this area. On the other hand, Boeing has gone into development of the aircraft, and the aircraft is now being developed. • **Boeing's investment** in development of the aircraft depends on how much money goes into development, and practically nothing is now being spent in this area. On the other hand, Boeing has gone into development of the aircraft, and the aircraft is now being developed.

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## Opposition From Major Airlines May Cripple Cargo Loan Plan

Washington—Opposition of major airlines may cripple the prospects for legislation authorizing government-guaranteed loans to the development and purchase of an advanced cargo aircraft.

Sponsored by Sen. A. S. Mike Monroney (D-Okla.) and Sen. Stuart Symington (D-Mo.), the bill provides for government guarantee of loans up to \$75 million for an individual airline for the purchase of cargo aircraft approved by the Department of Defense and the Federal Aviation Agency (FAA) Jan. 31, 1962, and the Department of Defense, FAA and the Civil Aeronautics Board as a stimulant to the development of commercial cargo aircraft which would be available to the armed services as an emergency.

Opposition to the bill comes from the airlines. The National Air Transport Association, National Airlines, American Airlines, Eastern Airlines, and members of Independent Airlines Association.

CAB Chairman James R. Ducker told the committee Jan. 1971 legislation providing government-guaranteed loans to local service lines has streamlined the purchase of 41 aircraft, totaling \$22 million.

Quaisis reported the estimate from their viewpoint.

• **The need for an "uncompromised" U.S. cargo plane** to return the nation's "relative" position in world commerce.

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loans would not increase our interest in the purchase of cargo aircraft." British Airways and Capital Airlines concerned that the development of the aircraft would be a waste of money.

• **Eastern Air Lines**, in a similar vein, said that "the fact that the loan guarantee is available would not create an adequate market."

• **Phoebus Dyer**, U.S. House, has purchased 16 Convair CL-440s under a Canadian government-guaranteed loan, reported to CAB that if the purpose of government guarantee is but a form of subsidy, flying light, for its part, would be a waste of money.

• **Fin American Airlines** said that "the government-guaranteed loan program is in no way essential."

The airlines which endorsed the guarantee of loans, used as an example, Northwest Airlines, National Airlines, American Airlines, Eastern Airlines, and members of Independent Airlines Association.

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## Braniff May Buy 3 More Jets for 1961

New York—Braniff Airways is currently considering purchase of three more jet transports for 1961; delivery and bill of sale seen between the Boeing 720 and the Convair 440.

Charles E. Beard, Braniff president, told the New York Society of Security Analysts last night that the longer the decision would be made by this week. It had become a difficult decision, he said, because of the potential advantages of each airplane.

When he listed for the 720:

- **Part interchangeability.** Based on experience during 85% of the parts of the 720 are interchangeable with those of Braniff's 707-212's now in operation or being delivered at an 15% price differential based on dollar value.
- **Engine availability.** The Pratt & Whitney JT3 engines of the 720 are not interchangeable with the JETs Braniff's 707s are equipped with, but the one more engine philosophy and associated long-term maintenance training problems. Also needed facilities would ease pilot training. Braniff is not interested in turboprop aircraft.
- **Size and cabin configuration flexibility.** would suit it in its purchasing the 720s with 707s on the line, thus giving the 720s great flexibility.

Those for the 440:

- **Lower fuel cost.**

An intangible advantage might be added to the list as indicated by Braniff's experience of operations for the 440 as a "boutique airplane." However, he also strongly pressed the 707, pointing out that Braniff had experienced only two mechanical delays with the single 707 it has operated since December.

Beard said the new airplanes, if delivered, scheduled in 1961 are worked out selectively, one be bought out of each fleet without the need for any further financing. Braniff will meet its peak jet depreciation charges that year, he pointed out, with the figure totaling \$7.6 million.

### Rotodyne Subsidy

London—Development of the Fairey Rotodyne VTOL will be subsidized by the British government up to \$11.2 million, according to Duncan Stoddart, minister of trade.

Agreement has been reached with Westland Aircraft, Ltd., which would use engine Avon Avonics (AW Jet 5, p. 56). Great was originally offered to France, which issued it down (AW Dec. 14, p. 35). Recovery of government's money a key to such loss control.

### Lockheed Cargo Plan

Washington—Lockheed Aircraft Corp. is studying the outline market in the process of setting a final configuration for a new midsize cargo transport powered by turbofan engines.

Based on the Super Hercules design offered jointly to the airlines and the Air Force last year, the new transport will be used primarily at the airline market, and delivery is not expected to depend on military orders. This would indicate that Lockheed intends to meet a substantial amount of its own needs in the project.

The proposed Lockheed cargo transport will use an advanced version of the T-38 turbofan engine and will be equipped with the Lockheed propeller.

Braniff's financing program on the sale of eight aircraft in 1975 and 1976, which would require \$16 million, long term lease from seven insurance companies of \$40 million and internally generated capital has been simple for its current jet program with its capacity for the purchase of 513 aircraft in short-term lease, which that was also available.

Beard's discussion of prospects for Braniff sounded somewhat optimistic in the New York financial circles, which has been making widely available programs for the last six months.

The airline on publication of profits for this year, but he did not give precise figures. Braniff's 1960 net income was \$1.1 million, or a 10% margin of 53.8 million. The company will not receive for 1961 of \$2.4 million.

Critics for lost focus on the area are based on addition of seating service not firm below, and on widening of charter service. Braniff has not been able to control many of the latter in the past because of equipment problems, he said.

Jet costs have been below estimates, he said, and lost focus on the jet line has resulted in the 60% level. Expected jet brochures lost for domestic flights, he said, a 90% and international 45%.

Because of leasing requirements, it will be late April before if Braniff has 707-212's will be an scheduled order. Jets will be used both on domestic and international routes and pattern equipment will be stopped, said E. Douglas DC-7Cs will replace

DC-4s, DC-6s will replace Convair 440-440s, and Convair 440 will replace DC-1s. Braniff's last three DC-6s (it was operating 25 a year ago) will be placed out in mid-1961.

Beard sees no replacement for the Convair even in the long-term board at this time. Turbine conversions of the Convair will not 15-20 costs a two mile more to operate, he said, and there is no room for adding passenger space in the airplane to compensate for this, said he. Braniff's main industry, a private traffic potential for such equipment. Braniff's many short stage lengths also cut the potential special advantage.

Some transport users expect their delivery this year as some jets are delivered, Beard said, but he does not expect this problem to become serious. If it prepared for often eventually, however, he pointed out that a fully operational DC-6 does not cost much for cargo work, and does not have a high fuel factor requirement to operate, possibly if the traffic is there.

Braniff will make a major effort this year to stimulate the cargo market. "We have a lot about being cargo doors," he said, "but our experience has been that the company must justify for cargo work and service. By the middle of 1961 we will know whether the company can be persuaded to fly cargo on our routes through lower fares."

This year Braniff will fly 21% of its available seat miles with 707s and 24% with Lockheed L-1049. Domestically, each will average 31% of a whole seat miles, compared with 14% last year, and first class the other 20%. On international routes Braniff last will be approximately 52% of available seat miles offered.

Domestic operations generated 88% of Braniff's 1959 total income of \$74,246,651, Beard and losses on the international routes dropped from \$399,606 in 1953 to \$131,960 last year.

### British Air Carrier Enters Bankruptcy

London—Independent Air Travel, Ltd., owner of the Viking aircraft which crashed at Southall, Middlesex (AW Dec. 14, p. 119), has gone bankrupt of \$793,213, it was revealed at the London Bankruptcy Court last week.

London's insurance of the crashed aircraft still is under dispute, and unless insurance money is received, uninsured creditors—who are owed \$678,777—probably will get nothing, according to G. M. Haldane, senior assistant official receiver.

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## Flying Crane Considered for Commuters

By Robert H. Cook

**Washington**—Use of flying crane helicopters carrying passengers in detachable pods is under study by Federal Aviation Agency in its search for a practical means of solving the transportation problems of suburban commuters and of downtown-to-suburb travel.

Flying crane approach is among five proposals for expanding the use of helicopters and VTOL and STOL aircraft which FAA is discussing in a national test of industry, transportation and communications under Project Humanoid. This planning guidance project is being conducted by the FAA Plans and Requirements Division, and the group expects to report by the end of this year on how the growing capacity of helicopter, VTOL, and STOL flight can safely and economically be integrated into the aircraft system.

FAA has launched Project Humanoid last January; the agency thinks the trend toward greater use of helicopters has clearly indicated that this type of air transportation is fast becoming one of its major areas of responsibility in the expansion of national aviation policy.

FAA has ordered 510 commercial helicopters, and FAA notes that there are three helicopter airlines in operation today and that the Civil Aeronautics Board has a current backlog of more than 80 applications for helicopter type ratings, which the Board will not approve until industry can produce an aircraft capable of making at least a break-even operational cost record.

Supporting construction of the bulk of a growing new transportation, in air transportation, FAA points out that greater attention currently is being given VTOL aircraft because of the recent lack of progress towards, built-in growth of urban traffic, present runway restrictions and the gradual addition of new roads and expressways which to maintain, causing aircraft manufacturers to explore new market potentials.

FAA feels that the state of the art in helicopter development has already surpassed existing regulations and that the state of New York's "Aerotaxi" order for Vertol 107s and Chinook Helicopter "Aerotaxi" order for Sikorski S-60s, FAA feels that it does not have firm rules for the certification of different types of aircraft. The agency recently suggested its own 25 lb. alternative helicopter operation in the New York area to aid in the formulation of the necessary regulations, and the rules should be ready by the time those operators put their new aircraft into service by late 1961 or early 1962.

In a survey of the operational potential of helicopter, FAA says:

• **Airport-downtown service** is essential to maintain and reduce the use of Vertol and Sikorski helicopter-powered aircraft may provide their operators with the first major breakthrough into a more profitable operation.

• **Short haul air-downtown operation** is an uncharted "bag of gold" which operation could tip, once airport and traffic control systems and loading are complex as acquired.

• **Between airport, including air taxi** operation, and downtown service, from such developments as the Alouette Model 210 engine which weighs only 95 lb. and can still lift 50,000 lb. guided by the project itself is a "breakthrough" that group feels that the state of the art in helicopter development has already surpassed existing regulations and that the state of New York's "Aerotaxi" order for Vertol 107s and Chinook Helicopter "Aerotaxi" order for Sikorski S-60s, FAA feels that it does not have firm rules for the certification of different types of aircraft. The agency recently suggested its own 25 lb. alternative helicopter operation in the New York area to aid in the formulation of the necessary regulations, and the rules should be ready by the time those operators put their new aircraft into service by late 1961 or early 1962.

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as a bus, the pod would cover a suburban area to gather passengers, then drive to the nearest heliport to be picked up by a flying crane. The crane would deposit the pod either at a downtown heliport or, in the case of suburban delivery, at the end of the subway line.

Pods designed such that flying crane can be stored between morning and afternoon rush hours, thus during the crane ascent to transport cargo to a variety of construction work.

Another source of the flying crane would use a crane and pod combination for an aerial tramway service between downtown areas and airports. Lifting passengers, baggage and all other services would be performed at the airport and could be done in a complex of downtown terminal buildings constructed on rooftops. Mobile lounge-type pods would be designed so passengers could disembark directly from the pod into the waiting aircraft on the rooftop.

Another method of the flying crane would use a crane and pod combination to carry out such a plan, although methods have been proposed in the past for pointing out that all transportation facilities needed by the traveler are already present in urban terminals which would be able to include a heliport.

Getting the aircraft into pods to carry out this plan would not be difficult, FAA says, as the use of lifts with manufacturers, but the major problem will involve community cooperation in supporting heliport sites.

## Continental's Sales, Net Profits Increase

Continental Airlines recorded a 1959 operating profit of \$1,132,000 and a net profit of \$1,524,000, with gross sales up 61%, \$44,883,000 for the year.

The airline's 1959 results included a net loss of \$152,000 on gross revenues of \$25,415,000.

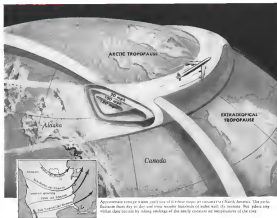
Continental's 1959 net profit included \$1,206,000 net capital gains from the sale of parent aircraft. Expenses were up 65% to \$42,155,000, interest increased from \$1,141,000 to \$2,351,000, and cash from all capital asset operations and profits was up from \$5,311,000 to \$10,765,000.

Introduction of Boeing 707-120 service between Chicago, Los Angeles, Denver and Kansas City was cited by the airline as a major factor in its record increase and profits. Passengers earned in the jet-scheduled Continental that totaled \$1,397,000 in 1959, an increase of 10%. Revenue passenger-mile total increased 60% to 876,975,000.



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Jet streams are basically a result of the marked temperature variations existing between the tropical, extratropical and polar tropopause, and are usually found curving along the broad areas where one tropopause overlaps another. Shaped much like a flattened tube, the streams are from 100 to 500 miles in width and from

2 to 5 miles deep. Wind speeds at the core are generally about 150 mph (though much greater velocities have been recorded) and direction varies and from the center.

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Delta Air Lines has taken delivery of the first of 20 Convair 440 turboprop transports. All 40 will be in service this fall. Delta also has six Douglas DC-8s, all in service. Smaller shown, the first production 880, is expected to be FAA certified about May 1.

## Delta Is First Airline to Receive Convair 880



Convair 880 can carry 34 first-class passengers or 120 coach passengers at 615 mph cruise. Range with full fuel-on-ground and normal reserves is 3,410 stat. mi. Typical CRJ means under sea level standard conditions, 5,370 alt. top is 8,200 ft. landing requires 5,300 ft. under most conditions. Four General Electric CJ405-3s are used at about 35,000 ft. thrust each.



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# BEA Chairman Forecasts 'Mass Market'

By Glenn Gerson

New York—British European Airways traffic, boosted by a boom in United Kingdom and European travel, was up 10% in 1959 and is expected to rise another 10% this year, according to BEA Chairman Lord Douglas of Kettlewell.

Lord Douglas told *Airtransport Weekly* that the era of mass air travel in Europe "is really coming about" and will be established by new, lower fares scheduled to go into effect this summer. BEA's 1959 net profit was about \$5,000,000 after a 5% provision on capital to the British government, Lord Douglas said.

In the meantime, BEA is considering purchase of two or three intermediate helicopters. Lord Douglas has flown in the Vertol 107 and Sikorski S-61 two-engine-powered helicopters and said BEA will have to decide within the next two or three months whether to buy one of these aircraft or the Boevert 102, after further consultation. These intermediate helicopters might be suitable for multi-channel operation, the BEA official said, and might be used on BEA's London-Rome city routes to serve small airports.

## Twice-Weekly Service

The carrier hopes London-Moscow service last April and in 1960 has compensated a 1959 load factor on the 1,600-ton route, which is BEA's heaviest. Viscounts now handle the twice-weekly service, with Russia's Aeroflot agreeing to lift its aircraft on a reciprocal basis. The 75 passenger Viscounts require a stop at Copenhagen, but the Council will operate nonstop over the route. Aeroflot DC-10s, which also have been stopped in Copenhagen as part of the current agreement, will then operate nonstop. The Russians are providing 75 seats to United, but data and tourist information, BEA's Council will be fitted with 24 first class and 60 tourist seats.

Lord Douglas said the BEA Aeroflot service has been handled rather "quite a good administrative arrangement," with a minimum of BEA personnel required at Moscow or Aeroflot personnel at

London. The British carrier has assigned safe one engineer to the Moscow end.

Telivision services are exchanged on a "look for look" basis," Lord Douglas said—and, without charge. Each airline maintains a small store of spare parts at the other's home base.

Moscow traffic is growing and will increase in 1960, the BEA chairman said, but the additional deposits provided by the Council will probably be enough to allow increasing scheduled American tourists make up most of the Moscow business. According to Lord Douglas, 50,000 Americans visited the Soviet capital last year.

In London, the language problem in the London-Moscow operation, both BEA and Aeroflot carry interpreters on their aircraft. However, the Russians have put English-speaking traffic on to traffic in their towns in Moscow and on a four aircraft service from and to BEA's Viscounts in the London-Penn route will carry 25 first class and 75 tourist seats. The technique will compete in the market with Sud Aviation jetliner equipment, but Lord Douglas said the difference in load, based on the 225-ton cost will be only about 1 ton and that the BEA official said, is the most important factor in short haul routes.

BEA's average load segment is not over 100 km. Its peak route is a route of 1,000 km, i.e., the London-Moscow. Generally, Vanguard will handle routes up to 500 km, Conquest the longer ones. On a 500-ton segment like Switzerland-Geneva, second Council and Vanguard schedules may be provided.

Lord Douglas faces his difficulties the various types of equipment, but in fact, from time that general agreement will be reached on such a route.

The 65 passenger BAC-111s will be operated from the center of London to the center of Paris and would be suitable for service between London and any large city within a 500 range. Lord Douglas said that these aircraft will not be competing in the mass market because fares must be higher in them. Even in the Redoubt market may be 25% higher than in fixed wing first class service, the BEA official said.

Describing the DH-121 as "a project still being set," Lord Douglas said it should fill a needed gap in the spectrum of equipment, such as the Viscount shipped into its use. The DH-121 "may well be a winner from that point of view," the BEA official said.

The DH-121, according to Lord Douglas, will carry 75 passengers in usual service as 100 economy passengers, for 600 mph and operate from 6,000-ft runways. At the moment, the DH-121 has got the field to itself; since the American aircraft had jet propellers such as the Douglas DC-9 are not moving ahead, he pointed out.

The BEA chairman pointed out the importance of carefully following trends in an airline's route pattern and that more airlines have money by trying to fit planes with too much range or payload into unsuitable segments. The case BEA has used in approaching this organization, Lord Douglas said,



Pan American Gets First Intercontinental DC-8

First intercontinental service of the Douglas DC-8 jet transport, powered by Pratt & Whitney JT4A (771) engines, was delivered to Pan American World Airways last week. Plane carries 22,000 gal of fuel, is certified for a takeoff gross weight of 550,000 lb.

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is illustrated by the 52-page BEA presentation for its Viscounts. The BEA official said the structure of lower and special fares effective this year in Europe was needed to absorb increased airline capacity and tap a true mass market. Also at special fares is to induce people to fly at odd times and thereby even out the peaks and valleys of business. To that end, fares are differentiated by time of the year, day of the week, hour of the day.

BEA considers the Air Union combination of four big European airlines as "a very desirable arrangement." Lord Douglas said "people keep talking about Air Union as a threat," but it is not considered such by BEA. He noted that BEA has good arrangements with almost every airline in Europe, involving scheduling and revenues. The airline has such an agreement with Air France, for example, with special fares to be used in several ways.

BEA operates good agreements with the other members of Air Union, too and hence "the more cooperation there is, the better it is for us."

A consortium arrangement between BEA and Olympic Airlines of Greece began operation in April. More such routes than a post agreement it will involve joint operations on several Mediterranean routes and others including London-Athens. Each carrier will provide three Conquest 40s for the service and serve BEA Viscounts and Olympic DC-8s also on the route.

Major terms between and outside of all the carriers will be done by BEA at London. Crews also can be exchanged for the jet operation, but this is not yet settled.

BEA, although it has no transatlantic route, brings a good deal of service business to the United States. Some \$10 million in this business will be booked in the United States this

year, according to Lord Douglas. The BEA chairman does not focus on increasing transport operations in the 1960s. Being a short haul airline, BEA would not be a supersonic project anyway, but Lord Douglas believes such aircraft generally are "longer runs than most operators desire," perhaps 10 or 15 years in the future.

## BOAC Management Changes Clarified

London—Slips-ups in the structure of British Overseas Airways Corp., named senior Member of Aviation Council, Sir George Gifford, managing the greater efficiency of the aircraft industry now are beginning to take shape.

Ministry of Aviation has confirmed a report that three new changes listed among the airline's top priorities. It announced that Sir George Gifford had named three successors.

In view of the speculation that has arisen about the membership of the board of BOAC, I should like to make the position clear. Last November, Sir George Gifford told me on account of demands of his private business he would not wish to continue as chairman of BOAC after expiration of his current term of appointment in 1961.

Sir George Gifford told me on account of demands of his private business he would not wish to continue as chairman of BOAC after expiration of his current term of appointment in 1961. I therefore said and intended, except for negotiation with effect from April '61," he added. Decisions on future appointments are pending.

A BOAC spokesman in London disclosed yesterday that Sir George Gifford, the airline's managing director, is listed for nomination to BOAC's deputy chairman.



FIRST FOUR of 20 Viscount Vanguard transports ordered by British Overseas Airways (AW No. 4, p. 67) are shown at York. Wicks, England, last winter when four Viscounts are being used in the current flight test program. First of 20 Viscounts ordered by Trans-Canada Airlines is scheduled to fly this month, seven others have started test assembly line.



Space probe reaches  
heights of over 500 miles—  
speeds of over Mach 10—  
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The Bristol Siddeley Gryphon, the world's most advanced lightweight turbojet engine, powers the Fiat G.91, SA-70 standard light-weight strike fighter. The Gryphon is in service in six different air-arms and is specified for eight others.



AND THIS

The Bristol Siddeley Proteus powers the Hercules tanker. Four Proteus give the Hercules a speed of over 600 mph—a range of over 5,000 miles. Hercules are in service with twelve nations and with USAF Transport Command.

## AIRLINE OBSERVER

Domestic tradeline prices on the New York Stock Exchange continue to follow a steadily dropping market. With one exception, most tradeline common stocks held close to 1960 lows throughout the entire year of last work, and several companies hit new lows for the year.

CSA, Czechoslovakian airline, is scheduled to replace its B-14 transport aircraft with Tu-104 turboprop transports on its Prague-London route beginning Apr. 1.

International Air Transport Association establishing a new fare structure in the Western Hemisphere has been tentatively approved by the Civil Aeronautics Board. Specifically the resolution adopted by traffic committee last year in Honolulu (AW Oct. 16, p. 18) calls for these changes: maximum baggage fees 3 to 5% on first-class fares, introduction of north-bound discount fares at 25% under actual income taxes and adoption of air surcharges ranging from 5% to 15%.

Northbound discount fares from Chile will reflect reductions of 20 to 25%.

Some British engine experts fear Britain is two years behind the U.S. in turboprop engine development and that this will greatly compound Britain's competitive problems in selling jet transports in world markets. They feel the British industry should abandon the long-range jet category and concentrate on competing with the U.S. with a short or medium range turboprop project. Obstacles to this idea include the technical lag in Britain's use of engines based on the wing, making installation of larger diameter turboprop engines a problem in current aircraft.

Port of New York Authority has partially automated its monitoring of jet takeoff rates at New York International Airport. An electronic system has been installed on a pole approximately one mile off the end of a runway. When these machines a system decided level, the automatic unit is tripped, and the reading is sent by wire to a special operations unit in the airport terminal. Other computers are still required by personnel in automobiles, but the electronic system may be extended later.

Federal Aviation Agency has amended Civil Air Regulations to require one pilot at the controls of an aircraft flying above 14,000 ft. to wear an oxygen mask at all times. All other flight crew members are required to wear oxygen masks that meet first-classing requirements.

Aerovias Ecuatorianas may lose its U.S. foreign air carrier permit to operate between Ecuador and Miami in Panama. Civil Aeronautics Board has asked the carrier to show cause why this permit should not be cancelled on grounds that the Ecuadorian government has cancelled the airline's authority to operate the route because it has failed to serve it for the past several years.

Civil Aeronautics Board members Allan S. Boyd and Whitney Gilliland have dissented against a majority opinion granting Flying Tiger Line an exemption that extends to June 30 on an agreement with Lockheed to provide two round trip flights weekly for the West German flag route between Frankfurt and New York. In granting the exemption, the majority noted that the State Department agreed its approval at being "in the national interest." In his dissent, Boyd said he did not believe that traffic should be diverted from U.S. carriers over an extended period of time. "By a simple course through the facilities of a U.S. carrier not restricted to meet the line under stress," he suggested two years as a minimum period for such lease.

Vickers-Armstrongs is preparing a freighter version of the VC 10 cargo transport with a midsuper. Vickers feels it has overcome difficult control and systems leakage of the freighter as gain significant weight advantages. This is because a joint in the nose does not have to stand the same order of aerodynamic loads that a wing tail layout would, the company said.

## SHORTLINES

British Overseas Airways Corp. will resume service to Cairo within the next future after a four year suspension of operations following the 1956 Suez crisis. The airline has settled all points of agreement with the United Arab Republic government. Ground handling operations will be conducted by Kuwait, the Egyptian travel agencies then.

Air Maroc of Morocco has picked up its option on a second Sud Aviation Caravelle. The French aircraft manufacturer has now received orders for 51 of the turboprop jetliners.

Lockheed Air Service has signed an agreement with British Aero Industries, Ltd., of Canada for inspection and maintenance services on the Fokker T60 turboprop engine used on the British Britannia turboprop transport at Lockheed's New York International Airport overhaul base. Service will be available to airlines with Britannia service into New York.

Military Air Transport Service has invited 35 civil air carriers to quote bids for transporting out-of-country cargo during March 1962. Bidders must be able to furnish weight with specific types of loading facilities and down capable of receiving large extremely heavy cargo. Bids must be received at Scott AFB, Ill., no later than 4 p.m. on May 18.

Nipier Engines, Inc., of Canada has appointed William C. Wood Associates of New York as U.S. & Central American sales agent for the Cessna 540 turboprop aircraft in its domestic and executive transport field. B. J. Vining and Aircraft Supply Co. of Washington will continue to specialize in the airline transport market. The aircraft, powered by Nipier's E1400 turboprop engine, has been in operation with Allegheny Airlines since July, and the aircraft has indicated fair usage of the aircraft, with options for an additional 15.

Pan American World Airlines is applying all action already on its Middle Eastern routes with turboprop aircraft and expects to complete the operation by the end of this month. The airline has received authorization from the Civil Aeronautics Board to suspend service to Mexico Airport at Manzanillo because the airport's runways are inadequate for operation of large turboprop aircraft. The United Arab Republic has advised Pan American, however, that a new and larger airport will be constructed at Manzanillo and that it will be in operation by 1962.



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At 30 it has 125 kc and so on. No matter what the bandwidth you can now record it at half the speed, at half the tape, at half the cost on the FR 600. The savings in just a short time can be substantial. If you use 10 14 inch reels of 1-inch, 1-mil tape each week your weekly tape bill is \$1500—minimum. An FR 600 can save half of that each week and thereby buy itself in 15 weeks. In your particular case it might take more time—or less—but it's a tremendous saving for getting the full FR-600 story. AMPLEX DATA PRODUCTS CO., 514 Chester St., Redwood City, Calif.

**This instrumentation recorder can buy itself in 15 weeks**

FR 600

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## Mercury Pilot's Orbital Role Described

San Antonio, Tex.—Important role the Project Mercury astronaut will play in successful orbital missions despite the high degree of automation being built into these vehicles, was described at USAF's Aerospace Medical Center, Brooks AFB, during a space medicine lecture by Lt. Col. William R. Douglas, the astronaut's flight surgeon.

Directed in his fully programmed suit, the selected astronaut will be taken out to the pad, placed in the capsule and tightly strapped into his zero-fitting, custom-made coach. This will occur approximately 2 hr. prior to launch time.

Actual preparation for the flight starts at least three days before the launch, Lt. Col. Stanley White, aerospace consulting staff, Langley Research Center, Va., noted. Control system preparation includes a special low-molecular diet designed to lessen loading of fecal wastes will be included. During the last day he will be isolated from all outside. Launch schedule will be planned watching solar flux activity to avoid a high-activity period.

### Capsule Checkout

After the astronaut is securely strapped in, the bid to the entrance hatch of the McDonnell capsule will be secured with 140 nuts, both end screws. Capsule checkout procedure takes approximately 30 min., so for approximately one hour the astronaut will not interact in the capsule waiting for T minus zero, or a sudden emergency abort signal, which will send him, three seconds later, 2,500 ft into the air with an acceleration lasting eight to ten sec. and peaking at approximately 25g.

If all goes well, the Atlas intercontinental ballistic missile carrier will accelerate to a peak of 1g in a little over 2 min., then a major event: the two booster stages fall off, and acceleration will drop abruptly to 1g but hold up to 9g by the time the sustainer motor burns out. The capsule will be controlled and then brought to a stop. Weightless period for the Mercury capsule and the astronaut will vary as the course of the flight progresses—each flight will scale up to those orbital carbo hours approximately 1 1/2 hr. more. 100 sec. will show the earth. Individuals accompanying flight with Mercury-type vehicles are in the planning stage for the next few years, Aviation Week learned.

At zero is separation from the sustainer motor, the autopilot stabilizes the capsule in about 1 sec. rotates a 180 deg. in the yaw axis in 15-20 sec. loss up in the pitch axis, so that the capsule is positioned in the attitude mode. This is to assure that returning into orbit at the nearest possible moment to avoid landing on the continent of Africa if for some reason or pre-programmed orbit parameters have not been obtained.

Up to this time, if all goes well, the astronaut has taken no active part in the flight, Col. Douglas noted, though during the phase he has a control panel role. For his own safety he must monitor instruments and indicator lights which will show him in proper functioning, or malfunctioning. His left hand will always be on the abort handle and he is capable of firing the escape rocket anytime after the Atlas carrier has separated 1 in off the launch platform. This enables to abort just to lift off a parachute, but it does introduce no element of uncertainty and dependency into the pilot's mind, Douglas explained.

From lift-off to zero into the orbit, he must remain alert and prepared to manually operate a number of vital items which normally would be taken care of by the automatic system, including activation of the cabin oxygen gauge, bottles to fill the cabin with 100% oxygen, jettison the escape rocket, so on after startup and separate circuits from the sustainer if these circuits are not done automatically.

Mercury capsule is so strong to develop an extremely solid capsule, with comprehensive response, no faster than 300 in./min. leakage, dependent on a new technique of manufacturing that will render heat demonstration, Col. White pointed out. The abundance of oxygen already provided in the environment makes it possible to achieve for greater amount of leakage, especially on early short flights. The astronaut will wear a suit that provides minimum leakage for the cabin system in the event of capsule rupture. It should avoid diffusion get beyond tolerable limits, he added.

At ascent into orbit, the pilot must be prepared to manually control the capsule for introduction of the auto control mechanism, which does not function, and after the stabilization in orbit he must then surrender the capsule to the autopilot for the purposeful observation of the earth and sky, Col.

Douglas noted. A single handle on the pilot's right side provides control over all three axes, configured into the center of the three rings of the sustainer around the main part. Pitch is controlled by wrist and yaw deviation of the wrist, yaw by flexion and extension of the wrist and roll by separation and pronation.

To further complicate matters, there is no aerodynamic damping in the vacuum of space, so once the capsule is started into motion by a control lever, it will continue that movement until the same lever sent an equal and opposite control from an applied position control by the Mission, capsule being supplied by hydrogen peroxide jets, with maximum thrust of the control providing up to 1.5 ft. thrust.

In conducting the capsule, the pilot will not rely on coordinated movements lateral. He will rotate the capsule in the yaw axis then in the pitch axis. Coordinated movements are not possible, Col. Douglas added, because of control cross coupling and given only 2 deg. of freedom. Redundancy alone provided the pilot with a conventional three-axis artificial horizon modified to give all these indications in one instrument to be used for scanning a window, so that he can see the horizon and a perspective so that he can view the horizon.

### Earth View

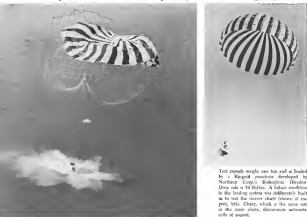
The earth-viewing periscope gives a field of view of the earth with a "magnification" of 8.7, presenting a 10 deg. view of the earth's surface in the inner 5 in. of the sight field. Outside the 5 in. circle is presented a view of the earth from horizon to horizon—the viewing angle of the scope being slightly more than 180 deg. With this periscope and strip maps, time clocks and other instruments, the pilot will be required to perform certain navigational problems presented to him before departure, such as determining time, over various early navigational geographical landmarks. The periscope will be used in no way for aiding and stabilizing astronaut in event of failure of more elaborate equipment.

In orbit, the pilot also handles other active tasks such as making periodic reports to ground tracking stations and returning vital instrument readings to routine data interspersed to the ground. He also will monitor cabin pressure, oxygen level, pressure and CO<sub>2</sub> since he may be the first to detect that these are reaching dangerous values and he is the



Full-size model of the Project Mercury main space capsule was used in the 15th successful drop to check the secure parachute release system. Drogue chute separates (left), main chute opens (right) and the capsule is lowered to the water in a USAF Lockheed C-130 transport which made the drop from 31,330 ft over the Salton Sea, Westwood, Calif. Cleanup of capsule chutes is at right.

## Radioplane Tests Mercury Capsule Landing System



Test capsule weighs one ton and is loaded by a Radioplane prototype developed by Northern Corp.'s Radioplane Division. Drop rate is 33 ft/sec. A radio antenna in the landing system was automatically built in to test the receiver chain (shown in the photo, left). Other, which is the usual use at the main chute, disintegrates automatically at impact.



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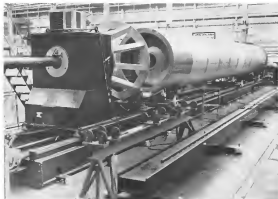
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One of eight 70-in. diameter tanks which will contain fuel and liquid oxygen for the Saturn space vehicle booster is shown in a metal working machine at Army Ballistic Missile Agency's Ordnance Arsenal at Huntsville, Ala. Booser will be 23.6-in. diameter when completed.

## Saturn Vehicle Tankage Takes Shape at Huntsville

Tankage for the Saturn I-V million lb. thrust space vehicle booster is taking shape rapidly at Army Ballistic Missile Agency's Ordnance Arsenal at Huntsville. The tanks will hold eight Kerosene-BLQ liquid fuel engines grouped in a cluster and each developing 152,000 lb. thrust. Much of the fuel will be carried in a liquid aluminum alloy; ballast tanks attached to these aluminum, light-weighted kerosene waste tanks containing fuel and liquid oxygen will enclose the boosters. The aluminum is about 1450, standard light weight. About 11 tons of 9450 are needed for the tanks. Forging also are of flat plate. Five open bulkheads (below left) are used in forming engine and fuel case patterns for the 70-in. diameter tanks which, in turn, are then

cast around the 16-in. diameter rods. After aluminum sheet is turned into the 16-in. segment (below, left). Placed in a metal working lathe, the sheet is turned to exact precise diameter when the cylindrical sections are joined. When completed, the entire tank will be 60 in. long. The engine cluster will be fast into this case as a static test stand which has been specially modified for the Saturn program (AW Feb. 5, p. 25); even though modified for the extremely high thrust, one side of the boosters will be used for static testing of liquid ICBMs. Huntsville engineers have completed a million gallon capacity steel water reservoir which pumps 90,000 gpm. to the blast deflector to spread flames and test from the tests.



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**IN 1959 ALONE**, the following figures indicate the emphasis MBVD placed upon this important factor of subcontractor teamwork on Air Force projects:

- Over 35,600 different purchase orders were placed by MBVD on subcontractors in 1959.
- More than 25,000 of these MBVD purchases were made from "small" subcontractor businesses.
- More than \$26,000,000 worth of goods and services were purchased by these 25,000 orders. This amount represented a major portion of the contract dollars received by MBVD.
- And more than \$13,000,000 of this \$26,000,000 went to "small" business firms.

If you'd like more information about G.E.'s Missile and Space Vehicle Department, its subcontracting activities, its re-entry vehicle progress or about any of the space technology activities, write to Section 100-70, G.E. Missile and Space Vehicle Department, 3150 Chestnut Street, Philadelphia 4, Pa.



Mr. William M. Polan, General Manager, Missile and Space Vehicle Department with Air Force re-entry vehicles developed by MBVD.

1. RVB-2 Re-entry Vehicle, the largest re-entry type in entry vehicle to meet for ICBM range and be recovered.
2. Recovery vehicle used in recovering Atlas-Agena re-entry vehicles.
3. Recovery equipment platform for RVB-2.
4. Recovery equipment for Atlas-Agena Re-entry Vehicle for the F-105 program.
5. Launch 2 re-entry vehicle (Atlas) which has been recovered and retained for use as a test vehicle for Atlas.
6. Launch 3, an advanced space-type re-entry vehicle for Atlas.
7. RVB-4, first sub-orbital re-entry vehicle to be recovered after full ICBM range flight.
8. Launch 2, first U.S. operational test of re-entry vehicle, one to use on Atlas Thor and Atlas missiles.
9. Typical ground support equipment developed by MBVD for Atlas and Titan II re-entry vehicles and missiles. (1) Launch 2 re-entry vehicle and missile. (2) Launch 3 re-entry vehicle and missile. (3) Launch 4 re-entry vehicle and missile.

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# JPL Studies Future Solar Power Units

By Richard Secor

Practical, Cold—Advanced technology for electrical power demands of lunar and deep space probes are being developed and evaluated at National Aeronautics and Space Administration's Jet Propulsion Laboratory here.

Power supply development, judged one of the toughest space technology problems, is being pushed at JPL to meet these ground future periods.

• One to three years. Solar cells will provide the power source in the near term, JPL feels.

• Three to five years, during which solar furnaces will produce high temperatures for transforming into electrical power through thermoelectric devices or to heat a working fluid which will drive another type generator.

• Six to 10 years, when lightweight nuclear reactors should be able to make heat for similar subsequent conversion to power.

Engineers at JPL indicate today's power supply state of the art includes possible miniaturized units ranging from 0.2 to 0.25 w. to one watt per pound of payload under operation conditions. Present JPL payload propensities will for 500 lb., plus or minus 200 lb. for lunar manned extraterrestrial vehicles and 300 lb. for deep space probes which include a guidance system functioning after initial installation. JPL feels that a two to one watt per pound of payload should allow for manned extraterrestrial probes for the next 10 years.

## Economic Aspects

Studies of various power generating techniques at JPL include analysis viewing these economic aspects.

• Using solar cells, price of each watt level will determine the energy consumption is from \$168 to \$700 perhaps \$1,000 under certain conditions. This is for hardware alone, with no development cost included.



PROPOSAL by Jet Propulsion Laboratory for a space payload configuration was two solar panels in a power source. Panels achieve payload would go to moon, Venus or orbit earth.

• Radioisotopes can deliver power at \$5,000 to \$1,000 per watt per watt of the using equipment.

• Nuclear reactor costs are not settled. There are several available approaches, each with associated problems which could affect cost.

Since the use of rotating machinery to generate power would compromise reliability in comparison with the use of solid state techniques, JPL feels the latter should be used in space vehicles where flight time exceeds 100 hr.

However, solid state avionics operators in space communications have brought new problems, such as changes in component reliability due to lack of air, compressed with standard capabilities, ratings used in air which were calculated for operation in an atmosphere environment. This requires a comprehensive, systematic, on-going program for avionics components to be operated in space vacuum, JPL feels.

Analysis indicated that greatest return for investment would be to use

power sources to meet electrical requirements, rather than camp sources. Power sources are solar and nuclear with output measured in watts. Energy sources include solar, fuel cells, and chemical energy sources, with output measured in watt-hours.

## Weight Increase

A plot of weight against time for modern power supplies, JPL says, shows energy sources, weight increasing with a slope of about 45 deg., while the power source curve shows constant weight with time increase.

• Power source is better than an energy source.

• Manoeuvring (three-axis) plan is made of power requirements, methods of satisfying them and necessary life time.

• System selection parameters are studied for reliability, efficiency, cost per watt and response.

• Power supply development and use is geared to payload weight and time requirements, using the most efficient method, with but comparatively small variation.

Current state of the art has solar cells operating at 8% efficiency in converting the sun's heat to electrical power above earth's atmosphere. The sun produces in space near the earth, 140 w. of heat per sq. cm., leaving 52% to be retained. Solar cell panel efficiency is a function of the area of the angle of incident sunlight, reflecting proper panel orientation to obtain maximum efficiency.

Measures of JPL's development of heat exchanger and deep space probe payloads. Engineers comparing the payload developed for the sun-con-

## Methods of Providing Space Power

Requires 4, 100 w. power level for 120 days for an unmanned Mars probe probe.

### A. Energy Storage Systems

Batteries — giving 100 watt hours per pound  
Solid-state — giving 100 watt hours per pound

### B. Power Generation Systems

Divided solar collector-thermoelectric device (collector weight—0.2 lb./sq. in. and 2.2 watts per sq. inch)

Radioisotope-thermoelectric device (collector weight—0.2 lb. and 2.2 watts per sq. inch)

An additional solar cell panel on Mars (1.2 watts per sq. inch)

47%

10%

30%

## Solar Power System Parameters

Power System Performance						
	A	B	C	D	E	F
1. Standard panel area—ft <sup>2</sup>	10	10	10	10	10	10
2. Number of panels each flight	1	1	1	1	1	1
3. Area packaged in array per panel—ft <sup>2</sup>	70	70	70	70	70	70
4. Total packaged solar panel capacity—W	160	160	160	160	200	200
5. Power system output required <sup>1</sup> —W	100	100	100	100	100	100
6. Power system output available <sup>2</sup> —W	10	60	50	50	160	170
7. Power system output margin <sup>3</sup> —%	-9	-7	-7	-7	-9	-17

<sup>1</sup> Higher efficiency solar cells.

<sup>2</sup> See Table 10 margin.

A, B, C, D systems would add with the earth or go to the moon.

E is a Venus payload. F is for Mars.

called Vega project generally are expected to be flown on the Atlas-Agena (AWT) 10, p. 71) with suborbital flights for some missions.

JPL selected 250 m as the nominal maximum power level for the Vega payloads. Solar cell panels that power for lunar and Venus missions can solar panels are used, each having 10 sq ft of cell area, while the Venus payload has 10 sq ft of cell area panels are used. The difference is because the first missions are toward the sun, the other away from it.

Transmittal heatconduction panels on which cells are mounted are fabricated from aluminum alloy sheets and feel case. The case has a profile in each cell which allows it to expand during relative thrust throughout the mission so that all are in place when the thrust period is over and the payload is in free flight in space. Because the case panel would generate a disturbing torque on payload attitude orientation, increasing the work of the attitude control system which keeps solar panels oriented.

### Single Effect

Individual solar cells have a 2 sq cm rectangular area. They are attached to groups of five, with the long edge of each slightly overlapping on the next to give a shingle effect. Shingles of five coating 52.5, yield 10 sq cm of solar heat converting area each, and are connected in series on the Vega panels. Shingles are bonded to panel surface with dielectric insulating but thermally conductive adhesive area, 92% of solar heat must be conducted through the panel and radiated in the dark void surface. Panels cost \$75,000 each for hardware alone—no development costs are added—but solar cells are the cheapest lightweight power source available for Vega payload missions.

While it is not considered the

maximum power level achievable with solar cells, JPL feels that with technical response and appropriate structural techniques research, this can be at least 10-15% below 11 years. Using the term "random shade" technique, the required increase in solar cell area could be added in increments as required in increasing distance from the sun on a rocket landing in Mars, Jupiter or Saturn.

JPL expected attitude control system for Vega payloads would be able to allow deviations of less than 10 deg before a significant power loss occurred, according to calculations under the case law, making requirements much less stringent for the two payloads involved in Mars and Venus flights than a one or two degree attitude constraint would be required. Exchangeable nickel cadmium batteries are part of the payload power supply to provide for dark side flight time.

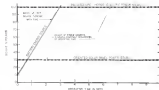
JPL considered a solar cell power source for Vega payloads but discarded the system because of cost and difficulties of generating potential orientation in case of damage. Batteries require maintenance throughout their life, and are not controllable by a remote JPL feels that government approval will be given to the nuclear power source before suborbital use is allowed.

Batteries, radioisotopes and other low power sources could be used, but the danger of leakage if upset coupled with the difficulty of extraction and orientation after landing make the scheme unattractive. Also, a storage system would have to be provided for dark side operation.

### Nuclear Power

JPL scientists are of the view that a nuclear power system would be a better repeating payload, much more data could be gathered and returned to earth, or data quality would be much higher, compared with batteries or chemical conversion systems such as fuel cells. Also, power available with a nuclear system would provide use of a battery in an unexpected payload, an on-board sub-orbit payload could have and in part in the same area, they point out.

Communications and power supply are closely related on unmanned, data-gathering payloads. JPL feels, however, that a nuclear power source would be the most efficient source of power. Power supply for communications had been generally established for the Vega lunar vehicle at 100 w.



COMPARATIVE weights as measured in JPL Space Power Group techniques reflect various stages of development debt, and systems. Additional elements—cables, etc.—are not included. At right is a batch of solid state elements in a regulating system.

and for Venus and Mars Vega missions at 160 w.

When permission is granted to use nuclear power sources in unmanned space, communications on these payloads no longer will be another possibility, but the problem will change to one of obtaining sufficient heat to power the nuclear components.

Although the Space Power Group at JPL is not working directly in nuclear reaction for power, according to the Laboratory's "no duplication" philosophy, there is a nuclear reactor effort being conducted by the Laboratory's Physics Section. The group is investigating feasibility of use also in reactor technology, which is related to power supplies in the heat source, and is not concerned with hardware.

Nuclear reactor use for power technology is feasible for orbital and space flights due to available control methods. Physics Section scientists say. Indications are that a reactor-carrying vehicle would be launched with control rods keeping the reaction from becoming critical. When start parameters are attained, an actuating system for nuclear operations a command signal could be sent to withdraw the rods, allow the reactor to go critical and start generating power.

Orbit criteria would be based on ensuring that if a vehicle deviated from the planned path or had a failure, control rods could be reinserted in the lower section to stop the chain reaction, and radiation from reactor fuel and other parts of the system subject to dangerous levels would have time to decay before the vehicle could possibly start a re-entry and be destroyed or torn apart by re-entry stresses. "The world present a major fallout hazard."

Nuclear reactors for space systems have been in development to suit various power levels. One is the 1.5 kw SNAP III reactor in the 30 kw, with expansion potential to 60 kw (SNAP VIII), a third system now in up for bid.

with a 100 kw capability (AWT Dec 21 1969, p. 21). All three generate power by using nuclear heat on a working fluid. The first two are converted to rotating machinery which generates the power, and it is anticipated the third also will be used with rotating machinery to generate power.

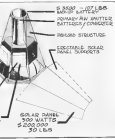
Expectations are according to the Physics Section that the first reactor generated in flight will be primarily to generate electrical power for a long-duration, low-thrust propulsion system such as ion or photon. Another power source would be a liquid.

The Physics Section is conducting theoretical investigations on nuclear power systems which would make use of so-called "exotic phenomena" for future space applications when advanced performance will be needed.

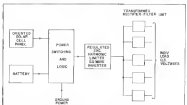
It also is studying space applications

of nuclear energy configurations to yield higher altitudes of reactor transport. This type nuclear investigation.

Early studies for propulsion (which the world supply heat for missions) to produce power, whereas the conventional chamber of a rocket engine is replaced by a chamber containing a critical mass of fissile material. Nuclear reactors are held in place by opening the chamber in products, structural loads, or in some other scheme. A working fluid such as hydrogen, is heated, then expelled through a nozzle to produce thrust which is produced in a conventional rocket engine. Some scientists suggested in several such reactor work in 1945 at Atomic Energy Commission's Oak Ridge Laboratory, are doing this work in JPL's Physics Section. Many other of this group is doing



DRAWING shows a possible solar panel configuration which would be used for a moon landing. The type might be applicable to the Atlas-Agena utility.



SCHEMATIC of circuitry for a typical power supply in detailed view. The system has provision for rechargeable batteries in addition to solar panels.





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\*Film sequence taken at intervals of 1/100 of a second.

tion toward solving the gas dynamics aspects of atom sources, previously the problems associated with separating the frozen material from the working fluid, and keeping frozen material in the reactor.

•Exact granulation of electrical power in the frozen process in separating and collecting the frozen fragments. Photo Science points out that this theory is not new, but the technology needed to accomplish it has been in development. However, as is plain experience among that theory has been completed on a typical fusimachete will avoid serious. Calculations show that a 2% efficiency is obtainable, using the concept JPL and Budd Corp are competing on this work.

### Atomic Particles

The Photo Science also is working on atomic particle acceleration, and though efforts now are at simulating supersonic environment near the sun, it is expected that later work will involve acceleration in space vehicle thrust generators.

Although current activities are heating working fluids and using rotating machinery to generate power, solid state devices which transfer heat into power without moving parts are under development—the thermoelectric and thermionic devices.

Thermoelectric devices generate electricity by passage of heat through materials similar to the thermocouple principle. JPL believes this approach is limited because maximum operating temperatures, which are the measure of efficiency, and now are estimated to be 650C to 700C, using materials such as lead telluride.

Thermionic devices generate current by the flow of electrons from a hot cathode to a cold anode, after which they are passed through a vacuum lead to accomplish work before returning to the hot cathode. Thermionic devices generally are based on thermionic diodes, and are of two types—vacuum diodes and plasma thermocouples. Maximum operating temperature for the device now is believed to be in the order of 1,100C, indicative of their efficiency equals over thermoelectric devices.

As last three to five years of research are necessary before either of these devices can be incorporated into flight hardware to succeed solar panels, according to JPL spokesmen.

Principles of thermionic power generation are that the electrons in the hot cathode develop enough energy from the heat input to overcome the force which tends to hold them in the cathode and is called the "work function." Work function level varies with materials. After obtaining a rate, they escaped the hot cathode, they have to move to

the colder anode. The electrons move through a vacuum, where their passage creates another force or "space charge" which tends to block their crossing.

To make the whole electron system have to overcome a self function, but it is less for the cold anode than the hot cathode. Electrons have a surplus of energy which is used when they pass through the anode, heat and accordingly useful work. Magnitude of energy surplus is the measure of efficiency of the diode.

A very small gap (0.0004 in.), between cathode and anode is used to overcome the space charge problem in a vacuum diode.

The plasma thermocouple has been generated with the cathode and cathode, which are spaced 0.005 in. apart. This gap means at the temperatures involved in cathode heating, and this ionization adequately overcomes the space charge problem while maintaining heating to ensure the diode case between the work function values of anode and cathode thus ensuring the device's efficiency.

The first heat source for thermionic conversion devices which most probably will be used in flight hardware, JPL feels is a solid fusimach. This is a container in which cathode and anode are used and fused into a polygon which has more area left open. The interior facets of the polygon cathode would contain a thermionic device to convert the heat to electricity. An absolute control system described in an automatic way under world attention some attention.

### Efficiency Increase

Currently, calculations indicate a 5% efficiency for individual thermionic vacuum diodes, but when connected in multiplex such as in the poly-gas solar furnace system, efficiency increases to about 15%, JPL says.

Reduction of vacuum heat drops thermionic devices will pose a problem, just as solar still face area. Also atomic components in the application of solar energy are not yet in the best design problems, with increased complications.

JPL's Space Power Group feels that the working of vacuum components in a closed system should be considered, based on surface temperature, which is proper heat in the vacuum level of the component materials closed in the passing thermal current. Interior heat causes component deterioration. The plasma step of part surface temperature in active life is significant because, without an atmosphere or growth in reaction, convective or conductive heat must be conducted away, be direct heat and contact between surface of the part and receiving structure.

After obtaining a rate, they escaped the hot cathode, they have to move to

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needed by pilot and airplane to change altitude sufficiently to avoid a possible collision may be alerted.

For example, suppose that tests show that a jet transport pilot requires at least 40 sec after alarm to execute a vertical escape maneuver. If a collision avoidance system can detect another aircraft coming up at or near own craft altitude and if it can predict how long before the two aircraft will reach near-same separation, the pilot would want to start an escape maneuver before the "minimum approach" signal was even 40 sec away (40 sec), regardless of whether the nearest approach might ultimately prove to be a safe or hazardous encounter.

Bendix Radio has proposed a collision avoidance system that operates on this principle. If there is neither air craft at own-craft altitude and the separation between them is continuously decreasing, the system calculates how long it will take before their separation reaches a minimum. Then, before the time to nearest-approach equals the minimum escape time, the system sounds an alarm and indicates whether the pilot should climb or dive. Because the Bendix system does not attempt to predict whether the situation will lead to a "reference" or a collision, the accuracy with which measurements must be made is greatly eased.

The first function which the Bendix collision avoidance system performs is to determine whether there are any other aircraft-craft at or near own-craft altitude. Each aircraft-craft would carry a small radio transmitter, operating in the UHF band, which would periodically broadcast a series of pulses 20 pulses where the spacing between individual pulses automatically varies in a function of the airplane's barometric altitude. The series of altitude-coded pulses might be transmitted every 50 sec.

A fully equipped airplane would then carry a radio receiver which automatically receives from all other aircraft in the vicinity, to determine which, if any, are at or near its own barometric altitude. When sufficient altitude separation exists, no action is needed and no signal is required to indicate that action is not now a threat. But if one or more aircraft are at own-craft altitude further action is required to determine whether they are a threat.

This work of the Bendix technique is not so stiff as it seems. Bendix aims for altitude knowing has been advanced by others.

However, because Bendix does not attempt to predict min distance, to determine whether an escape maneuver is required, it avoids the problem of accurate bearing measurement which has plagued earlier collision avoidance systems efforts. Instead Bendix tends to



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# Titanium trims DC-8 airframe

(equals 5 passengers, or 1/2-ton of freight...for life!)

DOUGLAS AIRCRAFT COMPANY, INC., has never built an airplane that failed to show a profit for its operators. Based on the experience of United Air Lines, the first carrier to fly the airplane, the latest Douglas ship, the DC-8 jetliner, indicates it will push that record forward. Here's how use of titanium contributes to the total efficiency of the airplane and what that efficiency means in dollars and cents.

The flying machine of the DC-8 jetliner provides its operators a basic economy almost unparalleled in current design: payback on every flight without restacks or development costs to be measured. That's how Douglas engineers view the value of titanium in achieving a maximum weight savings structure.

Primarily an aluminum ship, the DC-8 allowed few possibilities for weight savings during design. But where weight could be reduced—in pins and pylons, rig supports and door doublers—titanium was selected—680 pounds of commercially-pure grade Ti-25A for pins and pylons, 330 pounds of Ti-6Al-4V titanium alloy grade for rig supports and door doublers, 15 pounds of water-tightness between fuselage. Metal is supplied by Titanium Metals Corporation of America.

The net result is elimination of a half-ton of useless airplane weight for the 3,000 flight hours DC-8 is expected to make during its seven-year life-span.



Titanium comes next, through which DC-8 engine will be secured, as evidenced on the second fly over Douglas Aircraft Company Inc. employees. Parts of the DC-8 have been so designed that titanium will readily sell off its costs for.

Titanium of stream also played role in Douglas fuselage structure. DC-8 has 330 pounds of Ti-6Al-4V alloy ribbing produced by Titanium Metals Corporation of America.



## by 945 pounds

(interpretation of the value of weight savings follows)

- DOUGLAS AIRCRAFT: "The 1,000 pounds (all weight saved) are equivalent to five passengers and their baggage for the entire life of the airplane."
- UNITED AIR LINES: "At the very least, the weight saved by titanium is equivalent to a half-ton of cargo. At fuel rates, this would amount to a potential of \$325 for each coast-to-coast flight."

### Why titanium?

Titanium, with a density of 0.143 lb/cu. in., is produced in straight steel and/or supposing steel on a strength weight basis. Its resistance to atmospheric corrosion is permanent.

The reliability of titanium has been established with demonstrated clarity. Examples:

- DOUGLAS has employed titanium in every commercial transport since its first DC-7, where titanium in fuselage, nacelle and landing gear door yielded 300 pounds of weight savings.
- FLYT-100 VICTORY AIRCRAFT reports that more than one million flight hours have been accumulated by more than 2,500 P & W JT3D and JT4 engines using titanium components without a single failure of any titanium part, albeit through corrosion or mechanical fatigue. Both engines have been specified for the DC-8.
- According to titanium's reliability is so "designer property," Mr. Stuart Latham, President Hamilton, Bennett & McNEIL, INSTITUTE, made the comment in a lecture at Los Angeles March 19:

"We have talked much metallurgy from three bags made of titanium recently. To a man, they reported that 4,000 titanium pins mounted together, pins fabricated, pins fastened, and pins assembled into the airplane, it is usually never heard from again."

### Is titanium competitive in price?

Every Approximate. Certainly, which indicates the bulk of the titanium available employed in the DC-8, normally industry would expect far less of craftsmanship and the standard is detail is being to every job. Example: To guarantee aluminum cladding, Ryan's DC-8 door assembly located in San Diego has been so constructed that no doors or windows open in the direction of prevailing winds.

While avoiding no opportunity to improve upon simple results that titanium metal costs more than steel, Ryan has developed manufacturing techniques to fabricate titanium at prices roughly equivalent to steel. The special known "rigid metal" and completed assemblies is thus drastically narrowed after fabrication, even so, at assembly, far greater than raw material costs.

Multiplied titanium's fabricability is Ryan's production of the seven panels which cover the DC-8 engine. Three panels—thirty-five inches long which engine will be serviced for life—will be built from this section of 0.014" Ti-7A, 18" x 72", but which formed and welded together to form the skin of the completed door. Details, such as strength, strength, ribs and flanges are then welded or riveted to the skin. The completed product weighs 48 pounds and measures 182" long by 74" in the corners. Control of tolerance (maximum tolerances are 0.005") is so highly developed at Ryan that these tolerances are not merely a manufacturing rule but a specific value.

TITANIUM SHEET PANEL, which covers engine in DC-8 airplane with titanium details, data 182" x 72" and weighs 48 pounds. Titanium sheets are available in sheets or plates. Ryan's DC-8 door is a 182" x 72" x 0.014" Ti-7A, 18" x 72", but which formed and welded together to form the skin of the completed door. Details, such as strength, strength, ribs and flanges are then welded or riveted to the skin. The completed product weighs 48 pounds and measures 182" long by 74" in the corners. Control of tolerance (maximum tolerances are 0.005") is so highly developed at Ryan that these tolerances are not merely a manufacturing rule but a specific value.



### Where does titanium belong?

Titanium metal, built into the DC-8 is a basic design material, has been used in a variety of civil and military applications in a direct volume for volume substitution for heavier materials in a weight savings subject to general requirements in systems as required.

Although each weight reduction program and the standard dollar value must be viewed in relation to the specific application, titanium's permanent resistance to atmospheric corrosion yields dollars immediately apparent to operators of commercial carriers. It means it is 10 trouble-free hours operation each day when maintenance crews not only repair costs, but also down-time of equipment.

In pins, pylons, landing gear doors, ballbeats, struts and a host of smaller parts, titanium's weight savings are measured in profit. In projects such as solid and hard part metal, titanium's weight savings are measured in profit.

### Why Titanium Metals Corporation of America?

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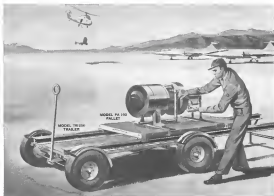
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### Saturn Static-Firing Results to Be Recorded in Blockhouse

Static-firing data on Saturn 1.5 million lb thrust booster will be recorded in instrumentation room of Ames Research Macho Agency test laboratory Blockhouse at Hawthorne, Ala. Master control panel in center of room will control type and shift clock recorder, parallel plug with ARMA as developing Saturn for National Aeronautics and Space Administration.

over, if both aircraft are at the identical altitude, the observation must be selecting the engine receiver cannot be made.

Present thinking at Bendix is that the first engine collision avoidance system to arrive at the conclusion that a threat exists and that both aircraft are at the same altitude can make an arbitrary choice of receiver, but will usually rely back on a derivative pulse to its internal broadcast which indicates its choice of receiver or that other aircraft collision avoidance system will know to select the opposite receiver.

Additional pulses may also be used to indicate when aircraft is climbing or descending, as distinguished from level flight, in order to predict a potential collision threat between an ascending and a descending airplane. Another pulse code may be used to coordinate ground-to-aircraft data so that they do not have self-wrecking capabilities and hence cannot be expected to make an engine receiver.

Bendix already completed the first phase of an FAA-sponsored program to develop the feasibility of ground-to-aircraft ranging which is the cornerstone of the company's proposed collision avoidance system. Flight tests were conducted at two different frequencies: 440 mc and 1,610 mc. The 440 mc transmitter had a peak power of 1 kw, the 1,610 mc transmitter had an output of 3.5 kw. Experimental equipment was installed in a Bendix DC-3 and a B-26.

More than 25 hr of flight tests were conducted at altitudes of 5,000, 8,000 and 12,000 ft over month-long, mountainous terrain and over water. Over 1000 terrain map-like collections of the ground-to-aircraft signal were re-

ceived and in some instances these results listed long enough to interfere with the test data pulse. I. K. Yates reported to CDPAAG. However, by increasing the spacing between successive transmitted pulses to around 25 to 30 microseconds, the problem can be eliminated, Yates said.

Yates indicated that 440 mc offers far better performance than 1,610 mc with the latter being about 15 db lower in reflected signal level. Small horizontally polarized, shielded, antenna were used in the aircraft to provide hemispherical radiation patterns. The 440 mc antenna measures about 3 in. in diameter, the 1,610 mc antenna measures approximately 3 in. in diameter.

The next step in the Bendix flight test program is to check the accuracy of the ground-to-aircraft ranging technique by means of extremely precise transmitters located in two aircraft. These tests are under way.

Bendix currently is negotiating with

IAA, for a contract to construct and flight test two complete collision avoidance systems incorporating computers for evaluating the threat and generating the escape maneuver signal. These tests are expected to begin this summer.

In the Bendix collision avoidance technique confusion is always possible. The IAA, the military services, the airlines and ground stations will face the question of whether to adopt the Bendix technique in the industry standard. An inherent disadvantage of one cooperative-type system is the fact that there is room for only a single type because aircraft cannot afford to carry multiple systems.

Bendix must now approach to collision avoidance equipment designs, or shortcomings developed by forthcoming flight tests, the Bendix technique may well become the industry's standard.

There would be little to become Bendix was one of the last of the major system manufacturers to propose a solution to the air collision problems.

### Communications & Electronics

Separately prepared Fiscal 1960 Defense Department budget report  
(in millions of dollars)

(see obligatory footnote)

	FY 1959	FY 1960	FY 1961
As Force	1674	1670	1700
Army	1300	1315	1379
Air	3030	3150	3400
Total	51,874	51,276	54,080
Equipment			
As Force	5804	5746	5766
Army	5109	5164	5161
Air	5155	5164	5169
Total	5942	5906	5996

# Low Temperature Coils Cut Maser Size

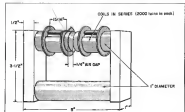
By Russ Miller

Lexington, Mass.—Size, weight and power requirements of solid-state Masers can be reduced by superconducting electronics developed here recently by scientists of the Lincoln Laboratory at Massachusetts Institute of Technology.

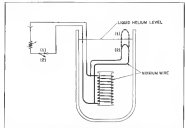
Made of coils of niobium or lead which become superconductive at the near absolute zero temperatures at which Masers usually operate, the compact electronics can supply stable magnetic fields for many hours at liquid

helium temperatures with practically no power consumption.

Solid-state Masers are extremely low noise microwave amplifiers which are finding applications in radar, radio astronomy and communications. In fact as the National Aeronautics and Space Administration's Project Echo. They operate at liquid helium temperatures (near absolute zero) to achieve the utmost in their low-noise capabilities. To the liquid helium bath in which the Maser coils and control are immersed, Lincoln scientists have now added superconducting solenoid coils.



REDUCED superconducting magnet used in laboratory tests is designed to reduce size of device needed by scientists at Lincoln Laboratory.



SUPERCONDUCTING solenoid is energized by external power supply which is disconnected after solenoid wire is dropped into position (S2) then establishing a superconducting circuit which supplies stable magnetic field.

in one case, supplied a magnetic field of 2,000 gauss for successful operation of an L-band Maser. Encouraged by these early results, they plan to use the superconducting electronics in a projected 8-mm Maser (SAE Jan. 11, p. 99), according to a Lincoln source.

Normally, magnetic fields are routinely applied to the helium bath's container to suppress the thermal energy levels of the Maser crystal within the liquid coolant. Some Masers have been operated at zero magnetic fields at the Willow Run Laboratories of the University of Michigan, but that use is restricted to a limited number of frequencies determined by the Maser crystal.

Consequently, magnetic fields must be supplied and this requirement for constant maser lasers, helix magnets. One superconducting solenoid, on the other hand, which supplied 4,500 gauss at 4.2K, weighed 10 lb. and measured 1 ft. in length and 2 in. in diameter according to S. H. Aulter in a Lincoln report in the development. The solenoid contained 11,000 turns of niobium, a metal which becomes ferromagnetic and which loses its magnetic properties when cooled slightly below 8.5K.

The superconducting electronics made at Lincoln are of two general types: the one solenoid, previously mentioned, which is made of turns of insulated wire in lead wire; and non-core magnets with one or more turns wrapped around a ferromagnetic core which has an air gap. The latter type, Aulter says, can supply stable fields—up to 14 kilograms have been measured.

Operation of a typical superconducting magnet (shown) as it might be used in a Maser is as follows: cooled in a helium cylinder, the solenoid was solenoid is immersed in liquid helium and is therefore nonconductive, as superconducting. It is connected in series with a power source and decoupled outside the liquid. A strand of niobium wire, insulated across the solenoid, is partially drawn out of the helium bath. Consequently, it is at a higher temperature and has a finite value of resistance. It does not draw any steady-state current in the process.

When the current supply is adjusted to a desired value by the rheostat, the drawing niobium strand is submerged into the bath. It loses its resistance and forms a closed superconducting circuit with the solenoid. The flow in this superconducting circuit cannot change; Aulter points out. The power supply can be disconnected, and the current will flow continuously at a steady power loss. In fact the only power losses are the dissipation in the copper

leads to the solenoid and in the external power supply circuit during the initial setting of the solenoid's current.

The upper value of a magnetic field applied by the superconducting solenoid is limited, Aulter says, because the inner turns of the solenoid are subjected to a field which can exceed the critical magnetic field and quench superconductivity.

Lead wire solenoids fabricated at Lincoln produced fields of about 100 gauss at 4.2K. Niobium appears to be better, however, in that it has higher critical fields and better mechanical properties than lead.

Much greater fields can be produced, however, with air-gap, non-core electromagnets. Although superconductivity is again quenched when the wire is exposed to fields in excess of the critical field, the field in the air gap can be considerably higher by a factor of the ratio of the lengths of the coil to the air gap.

For optimum design of the magnet a balance must be struck between two opposing design considerations: "There are a choice to keep the coils separated from the gap so they are not exposed to long-term flux and quenching at lower fields and keeping the coils sufficiently close to the gap to provide coil flux through the gap and to prevent core saturation at low gap fields."

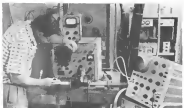
First-grown 10-mm superconducting electromagnets which required less than 1 lb. of liquid helium for cooling from 4K have been made at Lincoln.

Better superconducting electromagnets should emerge from work along the following lines, according to Aulter:

- Higher fields for solenoids are possible with materials which have higher critical fields if they can be properly drawn into wire. Niobium, therefore, for example, has a maximum superconducting (zero magnetic field) at 9.2K and at a critical temperature of 15.3K it has a critical field of 9,000 gauss. With non-core stress characteristics, niobium wire might provide critical fields of 8,000 gauss at 4.2K.
- Higher fields in non-core gap magnets, approaching the saturation value of zero (approximately 25 kilograms) are possible, and still higher fields are conceivable by using pole tips made of very soft metals, which become ferromagnetic at low temperatures.
- Higher magnets might be made with wires having high critical fields which would prevent coils of shorter length to be almost close to the air gap.
- Higher fields in large gap magnets should be possible with a better distribution of use and more efficient use of helium vapor.
- Horizontal fields can be obtained by the helical air gap coils and these fields can be obtained with subgaussian sets of coils.



MAJOR GUIDANCE radar for Terrier missiles are mounted in ballistics and varied by tests at Vicksburg, Miss. Large bladed, bladed-shaped sensors are each ballistics or its stage acquisition and the smaller disk-shaped sensors (shown) are its capture.



ALPHABETIC OUTPUT of the MFG-15 instrument is checked with specially developed spectrum analyzer to determine ground systems, and possible presence of high orbitables. The check can be run manually.

## Terrier Guidance Radar Tests Start

Good News, N. Y.—Extensive testing facilities for the MFG-15 Terrier missile guidance radar are now in operation at Sperry Gyroscope Co.'s Blackville Plant.

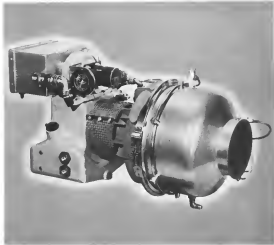
Involving an investment of about \$2 million, the facilities include nine radar batteries, a 30 x 200 ft. building for testing above and below deck operations, a target firing tower and a building for power and distribution systems.

These facilities are supported at Sperry's new plant by an antenna pattern receiving range with associated equipment.

Operating conditions and power requirements of the ships which are to be equipped with the Terrier are

developed throughout the test system. Special test equipment, including a spectrum analyzer, range indicator and waveform logic for measuring system parameters to required accuracies are included in the test facilities.

Tests are now scheduled on two guided missile carriers, the USS Boston and the USS Canberra, and on two guided missile destroyers, the USS Galt and the USS Downy. Tests which are expected to be carried out with Terrier include two Everett class aircraft carriers, two guided missile cruisers, a nuclear-powered guided missile cruiser, 15 guided missile frigates, a nuclear-powered guided missile frigate, and a nuclear-powered missile cruiser.



# HELICOPTER APU

*New Solar gas turbine 80 hp APU is only 12½ in.  
in diameter x 25 in.—weighs 59 lb*

SOLAR'S NEW gas turbine-powered helicopter APU occupies only 2 cubic feet—yet provides hydraulic or electrical power for complete checkout, for ground power and to start main propulsion engines. It makes helicopters completely self-sufficient, able to operate from remote locations with no ground support.

Powered by Solar's 90 hp Titan gas

turbine, the lightweight unit is simple to design, easy to maintain, can be started instantly—without warming—by temperatures from -65°F to 125°F and under wide atmospheric extremes. It operates efficiently in a variety of fuels.

Then gas turbines are using new standards of performance and reliability as propulsion units for new rotor helicopters, as portable electric gener-

ators and in other applications. For details, write to Dept. G-150, Solar Aircraft Company, San Diego 12, Calif.



## FILTER CENTER

► **Gallium Arsenide Promising for Diodes**—Gallium arsenide tunnel diodes developed by General Electric, which operate at frequencies of 4,000 mc and above, promise of repeating above 10,000 mc, also gave other advantages from using the new compound semiconductor material. For example, gallium arsenide tunnel diodes exhibit peak-to-peak current ratios as high as 10:1, compared with only 3:1 at best for tunnel diodes made of germanium, General Electric says. Also, the gallium arsenide diodes have a voltage, ranging up to 1.2 v., compared with only 0.45 v. for germanium and 0.75 v. for silicon. New central gate control structures of 1,000 to 10,000 amp per sq cm were constructed, approximately the same as 12-gauge house wire. These latter diodes give gallium arsenide tunnel diodes four times the power handling capacity of germanium devices, General Electric says.

► **Lunar-C Shows High Accuracy**—An airplane in deep space Lunar-C (formerly called Cetus), can determine its position to within half in. (95%) at the time when operating as far as 900 mi. away from one of the three transmitters or beacons to which it continuously sends out a signal at a rate on a system controlled along U.S. East Coast. Lunar-C also is operating in the Middle East and further investigations are planned. Using geostationary geosynchronous signals, Lunar-C provides high precision data out to ranges of 3,400 nautical miles during the day, as out to 1,800 nautical miles at night. Operating from six wave signals, Lunar-C can be used out to distance of 1,500 nautical miles during the day or 3,500 nautical miles at night with errors of about 1.5 in. Lunar-C is a low-frequency (100 kc) version of the older Lunar-A, which employs phase comparison techniques to provide the standard accuracy. Like the British Decca system, Lunar-C is a hyperbolic navigation aid. Recent evaluation was conducted by Janda and Butler, Inc., Washington, D.C., for Office of Naval Research under Coast Guard contract 6-5156, was originally developed by Sperry Gyroscope Co. under Air Force sponsorship (NAW Apr. 15, 1957, p. 101).

► **Flexible Radio Energy Pelletizer**—New device which makes it possible to generate a wave of any desired polarization (linear or elliptical) that can be caused to rotate at any angular rate without loss in signal power has been developed by Naval Research Laboratory, Radio Division. The NRL device accepts any

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## ALLISON PROP-JET POWER



### Radiation Detector

Measures radiation detector battery and can play as contained within single tube. Now about as pick up particles 100 times faster than previous detectors, according to developers, Hughes Aircraft Co.

Adjusts input polarization and resolves it into components of vertical, horizontal, right circular and left circular polarizations, which are available at four different wave guide ports. Relative amplitudes of these components detect wave input polarization. Unit has provision for local oscillator injection to permit laser connection to its mixer section. Frequency is meter feeds attached to the final output ports.

■ Signed on the Dotted Line—Major contract awards recently announced in various manufacturing include:

■ **Truck Instruments** will develop and produce 24 tachograph systems for General Motors vehicle under contract to Convaair. The FM/PM tachograph system must operate for 500 hr continuously without maintenance. Components has been received contract from Boeing for 37 tachograph systems to be used on Boeing models. System provides 45 FM/PM/PM channels.

■ **Westinghouse Electric Corp.**, Evanston, Ill., has awarded three-class small semiconductor tubes for Air Force under a \$95 million contract from Boeing Air Materiel Agency. Radar will include a 140-ft. Production of solid-state microwave device 3,120 ft.

■ **Land-Mc, Inc.**, Chicago will provide engineering and maintenance services to Army's White Sands Missile Test Center under \$7 million contract.

■ Navy has awarded six contracts totaling more than \$15 million for production of amphibious in the following companies: General Electric, \$5.5 million; Hamilton, \$4.4 million; Holman, \$1.3 million; Magnetics, \$1.3 million; Motorola, \$1.3 million; Sylvania Associates, \$1.3 million.

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**WIDEband** tape recorder to be used as Minuteman ICBM flight test has frequency response from 100 cycles to 250 kilocycles. Subsequent models will operate up to 500 kc. The all solid-state tape recorder was developed by Ampex Corp.

## Ampex Designs Wideband Recorder To Collect Minuteman Flight Data

**Redwood City, Calif.**—Transistorized, solid-state tape recorder which will record telemetry data during flight tests of the Air Force's Minuteman solid-propellant ICBM has been delivered to Boeing Airplane Co. by Ampex Corp., which developed the device. The first of 17 data recorders which Ampex is supplying for the Minuteman program has a recording frequency range of 100 cycles to 250 kilocycles at a tape speed of 60 in. per sec. In subsequent models, the upper recording limit will be raised to 500 kc. by increasing tape speed to 120 in. per sec.

Amplitude response is flat to within 1 db over the frequency range the company says.

The recorder provides up to 14 data tracks when a 1-in. wide tape is used. The model supplied to Boeing will use a 1-in. wide tape, providing seven data channels. Three of the channels will be used to record pulse code modulated (PCM) data, while the remaining four will be used for conventional FM (FM telemetry) data. An additional track for recording operator voice is provided which occupies only

0.005 in. width along one edge of the 1-in. tape; hence this width on the 1-in. tape.

The recorder is the first all solid-state sailing recorder ever developed by Ampex. Transistorization is suggested to improve overall reliability as well as eliminate long warm-up time previously required. Design objective was to have the recorder operate for 720 hr without failure or degradation from specified performance. The recorder was developed by Ampex with its new design and will be added to its company's standard product line, it says.

In addition to standard tape transport speeds of 75, 15, 30 and 60 in. per sec., the recorder has a high-speed search capability which permits the tape to be moved in either direction at speeds up to 200 in. per sec. A manual 14-in. reel using White tape, provides 24 in. of recording time at 60 in. per sec.

The machine is equipped with an audio which provides a time line of up to present damage to recorded data when the tape is installed or removed from the recorder.

## NEW AVIONIC PRODUCTS

### Instruments

• **Precision generator** for triggering or gating logic systems provides separate 4- to 60-megacycle pulse. Supply voltages and currents are: 4 v., 1 ma. to 10 v., 50 ma. Harvey Wills Electronics, Inc., East North, Industrial Park, East North, Mass.

• **Phase angle meter**, Model VMA-104, readable for sine waves at frequencies from 60 cps to 45 kc. as specified for use. Measurement range is 1 mv to 100 v., full scale, in 12 steps. Meter provides independent nulling of reference and quadrature voltages, 1-megohm equivalent input, 55 db, and nulling sensitivity of 10 microvolts. Designed for bench or rack mounting, meter measures 19 in. x 5 1/2 in. x 9 in. North Atlantic Industries, Inc., 660 Main Street, Waltham, N. Y.

• **Magnetic tape recorder/reproducer**, Type V-157A, operates in five selectable modes of recording and playback—single, FM, FDM, CM (composed modulation) and digital. Changer is accomplished by plugging in appropriate signal amplifier. Certain amplifiers available from front of console, boost recorder signal output to adequate level for parallel driving of multiple galvanometers chart recorder, and other related devices. Consolidated Electronics Corp., 360 Stern, Monte Vista, Pasadena, Calif.

### Telemetry

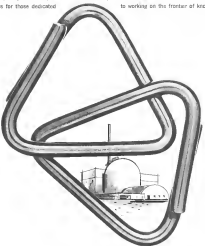
• **PCM telemetry system** multiplexes and encodes 64 analog channels, and processes five 5-bit parallel digital data channels besides a serial digital data channel at nominal bit rate of 200 kc. High speed multi-phase carrier logic.



and low level data or combinations of both with single low level amplifier. System weighs 25 lb. and is packaged in 3 cubic foot. Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Tex.

## SOLVING THE PUZZLES OF NUCLEAR PHENOMENA

In the advancement of knowledge of the peaceful uses of nuclear phenomena and effects, Allied Research engineers, scientists and technicians have made significant and continued contributions. The company's recognition in this field has been established by its participation in all major Atomic Energy Commission tests since 1951, and has resulted in the development of new concepts, devices, instrumentation, and data reduction methods as well as in practical applications in structural and design criteria. Similar recognition of Allied Research's work on the frontier of knowledge has occurred in many other areas of interest... aerodynamics... applied mechanics... aircraft operations... chemistry... electronics and instrumentation... geophysics... materials research and processes... meteorological systems... physical metallurgy... propulsion... physics research... systems engineering... vibration engineering... weapon systems analysis. These unusually broad capabilities have created outstanding career opportunities for those dedicated to working on the frontier of knowledge.



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Here is Francis Ahern, Manager of General Mills Digital Computer Laboratory, checking one of our newest computers which he helped design. General Mills computers, both analog and digital, are being used in robotic



guidance, tracking and guidance systems, automatic surveying and in industrial control. In future space travel, computers will help control navigational systems of space vehicles and will process data gathered in outer space.

Mars seen from one of its moons

Illustration from book written for General Mills by Willy Ley

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and mathematics. Some of the studies representative of these activities are: ions in vacuum, deuterium sputtering, dust erosion, magnetic materials, stress measurements, surface friction and phenomena, trajectory data and infrared surveillance.

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**Wright-Patterson AFB, Ohio**—Following is a list of unclassified contracts for \$25,000 and over as released by the Air Materiel Command.

Aircraft Equipment Division, R. C. Allen  
Washburn Washburn, Inc., Grand Rapids  
MIch, III av. Inflation, here and else-  
where, see Type MD 8, in accordance with  
specification MIL-I-1990A, dated Feb. 6,  
1956. MIL-STD-883C, Method A, for MD 883A,  
and Tolls above; (FPA) KA-511-p-1027  
and KA-5, 511-1027, 1027.

[illegible]

The *Eastern Ties and Shakes Co. Army* (also 210 on wheel assemblies) made 20x4 type VII Axles 61-1112 205 ax. loads assemblies On 20x4 205 wheel Axles 61-1112 and 205 assemblies for V-20s assembly of 61-1112-1000; 100.

Debra W. Virsik Co. Division, Verizon, Inc.  
BellSouth Corp., 146 International Drive  
and Atlantic Boulevard and Bell  
and Atlantic Boulevard, 146  
International Drive, Atlanta, GA 30303  
Debra W. Virsik, Director, Verizon  
BellSouth Corp., 146 International Drive  
and Atlantic Boulevard, 146  
International Drive, Atlanta, GA 30303

Weather Co., 904-1,2010 Pkwy. S., 44-gallon drums to support 400.5 barrel compaction in 30.3 barrels (PR 823-8-Fla-88970 \$87,816).

[illegible]

**Ingens Products International** Airport Mall, Brea, Arroyo Blvd. E., Los Angeles 90012, T or 800-441-4444, Ingens Products Inc. 140 and 14000, IPR C-001121 244-112

Winn-Dixie Stores, Inc., 10000 W. 11th St.,  
Minneapolis, MN 55426  
Tel: 612/338-1111  
Fax: 612/338-1111

Paul Almond Engine Department, General Electric Co., West Lynn, Mass. non-operations YAL-01-1 with jet engine in Air Vehicle Guidance Group (PA 87-0-110) 6010 40130

Fluorescent Control Strains: Results obtained using fluorescent strains (40 to 400 cells) indicated incubation ranges 100 to 400 hr (range 100-150 hr, Azusa 95-1782 (400 P/10002) P-1004 and P-1005 at 1000), 150 to 200 hr (range 100-150 hr, Azusa 95-1782 (400 P/10002) P-1004 and P-1005 at 1000), 150 to 200 hr (range 100-150 hr, Azusa 95-1782 (400 P/10002) P-1004 and P-1005 at 1000).

**Included Components:** Biotin; Enzymes (e.g., Nuclease, Mann); 1 ml. Capillary Sampling apparatus assembly model MPT-30-D; 1 cu.; Pipette; Reagents; Specimen container model MPT-19-B (PK C-enzyme solution).

**Leonard Anderson** Associate, Inc., New York, producer of 45/46 action picture films; investigation—(FT: 306 C-367-6411); 612-767

## Dulles Outlines CIA's Intelligence Role

ingest or hostile intent are threatened. These bats, based on long experience, are afraid that the female is really late, the pup, and we only have some forty years' experience in dealing with international companies of the Moscow variety and 12 years' experience with companies directed from Beijing.

Today is the Soviet Union more information is becoming available to the outside world than was the case in the past. This applies particularly to the development of Soviet provincial economy, their scope.



Allen Welsh Dulles, director of the Central Intelligence Agency since early 1959, has been authoritatively reported

The same which Kharatishvili has laid on his table, as he prefers to call them, and the endless discussion in the Congress and in the press about where we stand in the world race, has inevitably diverted considerable attention to intelligence questions. There seems to be some confusion about what I meant about the methodology in this expression. I should like to say to you that simply

Suburban and Council

He re-entered government service in 1942 directing the activities of the Office of Strategic Services in Switzerland throughout most of World War II. He returned to his private law practice shortly after the war only to come back to Washington in 1946 for a "six weeks" tour of duty on the staff of CEA's first director, Gen. Walter Reuther Smith. He has been there ever since.

First, our intelligence estimates do not attempt to give a complete picture of all elements as to what we stand to see via the USSR, in weaponry. We, as intelligence, are not authorized on American military program. Naturally our own domestic exposures and our knowledge as to the state of the art in the country are useful guides in judging others' capabilities. Our job is to determine where the Soviet Union now stands in the missile and other military fields and where it is going in the immediate future. We are not in the business of

To the creative engineer, there is nothing more stimulating than to work in a creative environment. Space engineering programs now in progress at Martin-Denver demand unusual creativity and may be your ticket to the personal and professional achievements which you are seeking. Make your desires and qualifications known to N. M. Papp, Dir. of Tech. and Scientific Staffing, The Martin Company, (Dept. CC3) P. O. Box 179, Denver 1, Colorado.

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CREATION WEEK, February 13, 1960

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going upon whether there is such a bug as a missile gap.

**Second.** The analysis of any given Soviet weapon system involves a number of judgments. These include, for example, Soviet capability to produce the system, probable Soviet uncertainty of the weapon system as of today, the role assigned to this system in Soviet military planning, the weapon itself, the Soviet high command may lay down for the weapon over the future. All these judgments are to some degree rather disputable. They lead to a calculation of how far and how soon the Soviets are likely to develop the system. Manifestly this kind of estimating is of the highest importance to our own planning.

#### Basis of Estimates

**Third.** It is difficult to predict how much emphasis will be given to any particular weapon system under the research and development stage has been completed, tests of effectiveness have been carried out and the factors given the order to proceed with serial production. No group of people knows this better than you do in regard to our own military program. Consequently in our estimates we provide three capabilities as the only step of Soviet weapon development and thus, at some hard facts as available we estimate their probable progress, sometimes referred to as scenarios.

**Fourth.** What I am describing is not a new or novel procedure. Even outside of the matter regarding military hardware, in respect of the type of weapon, whether it be a missile, a submarine or an airplane, progress through the period of infancy in the intelligent community and has done so for some years. That we assume the Soviet capabilities in each of these fields, and then in the relative accuracy and as a picture begins to emerge, we make our estimate as to the likely contribution to our own.

The fact that in the later years of development we can crack into the relatively more of the cleavage of progress and future intentions than we can of the beginning does not indicate any change in the obstinate approach to the problem. It merely means that our means of information in one way or more point of a project which is often needed by the planner but one which could not have been properly made earlier.

#### Soviet Bomber

For example, in 1954 the Soviets began production of a heavy bomber comparable to our B-52. Every indication pointed to their having adopted this plane as a major element of their offensive strength and in an attempt to produce these planes more or less as fast as they could. Based on our knowledge of their aircraft manufacturing industry we projected a buildup of the bomber force over the succeeding several years. We were certain that they had the capability to produce the numbers because the available evidence indicated that they had the intention to transfer this capability into a program.

But we actually kept a close watch on the actual events. Production did not rise as rapidly as it could have. Evidence as indicated that the performance of the plane was less than satisfactory. Now

## THE GRAND CENTRAL REPORT

### HAVE YOU HEARD OF 'FACILITY X'?

Almost two and a half years ago, Grand Central Rocket Co. dispatched a letter to the Ordnance Ammunition Command of the United States Army, proposing that we might be of help on an aerial solid propellant production program which the Army was at that moment considering. The need for this program—labeled "Facility X"—was indicated by the technological trend toward the macro-economical solid propellant missile. After consideration, the Army decided to establish a consortium for conversion and operation of this facility.

As a company of 600 highly-screened and carefully selected employees who in eight years have built a good national reputation for accomplishment in the solid propellant rocket field, we approach every challenge with five weapons: superior intelligence in solid rocket knowledge, common-sense business judgement, enthusiasm, perseverance, and the American concept of private enterprise. Our approach to this competition was no different.

On December 17th, 1958, the Ordnance Ammunition Command of the Department of the Army announced the selection of Grand Central Rocket Co. to establish design criteria for conversion of an existing ordnance line at Kansas Ordnance Plant. If the conversion of this facility is carried to completion, Grand Central Rocket Co. will be the operating contractor.

We are proud of the part which we have been selected to play in this important project, one about which you are going to hear a great deal more.

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## TO REACH THE MOON... MEN AT WORK

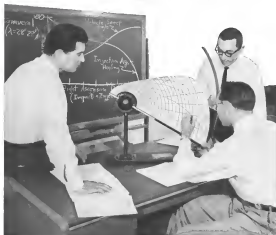
These men are ARMA researchers. They are putting to use a three-dimensional Trajectory Analyzer, designed and produced by them to provide simple, visual understanding of the complexities involved in guiding missiles to interplanetary bodies.

Today they use it in their studies of trajectory kinematics and missile guidance in lunar orbits. Sometime soon they will employ it to study travel to other bodies.

The Trajectory Analyzer—with which the trajectory of any complex-actuated or real missile can quickly be plotted in gross pencil—demonstrates the ingenuity and analytical ability of ARMA's imaginative research staff, creators of the Atlas ICBM inertial guidance system. Their experience and performance are unequalled in the broad field of space navigation.

ARMA, because of its people, will lead many of the careers in instrumentation, ARMA, Garden City, N.Y., a division of American Bosch Arma Corporation... the future is our business.

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While we noted progress in these missile testing programs. At about just about 1957, the Soviet leaders decided that the heavy bomber position should be held down to a minimum. In their eyes, missile guidance was a country now writing about the coming bomber gap.

As a good evidence of that change in position, it became noticeable on so to speak our intelligence estimates, and we did so. The capability remained, the policy and hence the means to go forward with the heavy bomber changed. That Khrushchev himself has been mentioned in his recent speech. In the field of missile defense and conventional weapons, Soviet policy went through a similar cycle in order to prepare the most sophisticated types of submarines. But this recently been shifted to by Khrushchev but was known to the intelligence community for many months.

In using these examples of mistakes as the numbers of Soviet mistakes and such changes, I do not wish to leave any impression that I think the Soviets will do the same in the long-range missile fields. During this past year they have been carrying on an orderly program of flight testing that we also which permits certain conclusions to be drawn. Most recently, presumably for the propaganda effects they hope to get, and because they were running out of known land space in which to test, they have advanced where in the Pacific they proposed to target the tests of their space vehicles or rockets for the month ending Feb. 13. Then they fly their missiles in public whereas in the past they have been doing it without publicity. They seem to rely in fact on the strength of that move.

### No Underestimation

There is no tendency in the intelligence community to underestimate Soviet capabilities in any phase of the missile field in the progress they have been making in developing their long-range missile effort. We have not disregarded the extent that you in contrast with last year.

However, it would be not so wrong to let the Soviet side, the world side believe that the ICBM provided as it is considered the only instrument with which a country should equip itself. I believe that the Soviets are taking in the advantage of the publicity they have achieved with respect to both missile and space programs in order to make the unimpaired believe that these achievements mean our all superiority in the military field. Such superiority as the the degree of our, qualified experts than I don't see it.

In various problems, such as the Soviet strategic attack capabilities with missiles and other weapons we as the intelligence community are likely aware of the impact which intelligence estimates may have upon our own military posture and our military preparation. I can assure you that in preparing them we look to nothing but the available facts, disregarding all outside considerations, political, ideological or other. At least we have been experimental. At times we have underestimated. But looking back on the last few years with the benefit of hindsight, the serious misestimate is a credible. From here on politics. We are all guilty of making and interpreting the facts without bias or error.

As regards the influence of a particular

intelligence effort or service on our diplomatic posture, I imagine that we are all human and have our prejudices and our strong convictions. I can also assure you that we have such a level of responsibility in making a broad cross section of both civilian and military participation on the United States Intelligence Board that there is little opportunity for personal whims or confusions of any member to influence the final product. But at any member of the Board has a dissenting view of any one, that member is entitled to express it in part of the minutes so that the policy itself can judge of it as such.

In addition to reaching sound, fairly good judgments on the crucial issues of the day, the other major portion of the

intelligence effort is to get the reports and estimates before the decision-making officials of government. In our own government, the means of course that the intelligence goes primarily to the President, the secretary of state, the secretary of defense, and the National Security Council. The latter is, in effect, the President's Council, to which the Central Intelligence Agency is under law primarily responsible. Of course, as we see today, intelligence is also made available to the Congress, as appropriate, to help in the legislative and appropriation processes.

For history, as I suggested at the outset, is replace with accuracy where the intelligence was available but the intelligence effort involved in the handling of it, as well as elsewhere where the work



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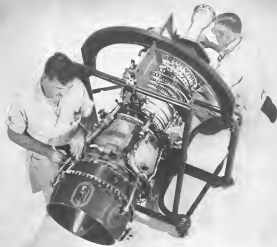
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**FOR MORE INFORMATION**—Brochures are available that describe the T64 engine in detail. If you would like this information, write Section 223 31, General Electric Co., Schenectady, New York.

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General Electric's Small Aircraft Engines Department also produces the T63 and CT38 turboshaft engines for military and commercial helicopters. The J85 turbojet engine for aircraft, missiles and drones and is presently developing the new T700-1 turbojet engine for medium and light weight aircraft. These engines are a part of G.E.'s growing light power spectrum with over 15 million hours of accumulated flying time.

**T64 RELIABILITY** will go hand in hand with outstanding performance. A unique government contract which calls for 10,000 hours of engine running by the time all configurations of the engine are qualified will help ensure both reliability and performance for the T64 engine.



LOW SFC AND HIGH POWER-TO-WEIGHT RATIO make the General Electric T64 turboshaft and turboprop engines ideal powerplants for many military and commercial aircraft including STOLs, helicopters, airplanes and other VTOLs. These are illustrated above in a composite artist's drawing.

Both fuselage and wing-mounted installations are possible with the various configurations of General Electric's T64 engine. This flexibility plus T64 high performance can provide important benefits to aircraft manufacturers and users.



**BUILDING BLOCK DESIGN** is a principal feature of the T64 engine. Turboprop configurations are obtained by the simple addition of reduction gearing to the basic turboshaft engine. This means standardization of parts and simplification of logistic support for users.







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## BUSINESS FLYING

### Mooney Predicts Higher 1960 Volume

By Ervin J. Bulfin

Kennedy, Tex.—Dollar volume of more 51.3 million in business aircraft sales during 1959, compared with approximately \$2.5 million last year, was predicted for Mooney Aircraft, Inc., by President Hal Rachal during the distribution and dealer annual meeting to which is the company's new model.

With some 600 four-place Mooney Mark 20s out in the field, the flying pace is that the company is now well past that initial period where lack of public response keeps its growth rate—indeed, it has been predicted growth rates that have been possible in the past. The production rate, although higher this year (expected at 125 units) compared with last year's 741 units, is being held back only by introduction on the new structure in August of the new 210 hp Mark 21, a higher powered version of the 160 hp Mark 20A.

As recently as 1957 Mooney delivered 42 units of a dollar volume of \$1,045,900, which provides some perspective on the company's growth.

Greatest output of Mark 20As is one complete aircraft every 12 working hours. This will amount to one unit every eight hours in May, which will be around April August when a spare schedule is developed with the Mark 21 phasing in with Mark 20A production.

Financial aid to the directors Mooney will be spring for a its most responsible of Ralph Hansen as chief engineer and vice president-engineering. Hansen has a long background in business, mainly development programs, including top design responsibilities in the past with Beech on the Bonanza, Twin Bonanza and Mustang, among others, and with Cessna, where he had experience over the four-engine powered Model 630 and then with McDonnell, where he worked on the four-jet Model 119.

Hansen's appointment indicates that Mooney is planning to expand its engine line and also pursue a number of far advanced projects. Rachal told the dealers "don't be surprised if in 1970 you see Mooney with a six-place turboprop business airplane that cruises at 800 mph." This doesn't mean that the company has such a place on the drawing boards, or that Hansen will start sketching one immediately, but it does point up near-constant thinking as company plans to

move up out of its current position. Rachal said that he thinks Mooney should strive to be one of the Big Three in the industry in the future—a leading name that now includes Beech, Cessna and Piper. Increasing acceptance of the Mark 20A in Latin America, he says, will probably result in the airplane becoming Number 1 there before it enters such status in the U.S.

Rachal struck out in Federal Aviation Agency's stand as Aircraftman Director, which he said was of serious concern throughout the industry. Ever since CAA became FAA, he claimed, the "A.D. Club" in Washington has been in here bickering in letting the aircraft manufacturers with certificates—some pending, some not. If a manufacturer comes up with a product improvement on his own, very often he is hit with an Aircraftman's Directive note, requiring costly re-evaluation, even though the part in question has been satisfactory. Rachal contended.

This policy he noted, has been of considerable concern to companies because of the direct impact on the customer, especially those who may just have taken delivery on a new airplane only

to be faced with a modification and costly change.

To answer this situation, Rachal announced that effective during the meeting, Mooney will push up the bill for all John Aeronautical Directors that are issued on all Mark 20 series aircraft, from the initial production model, which first came off the line in 1957. In carrying out this major policy decision, the company is setting up these guidelines:

- Mooney will designate the repair stations where the work is to be done. The stations will be chosen on a basis of proving that they are qualified and located convenient to the customer.
- Compliance with the A.D. must be accomplished within 60 days of issuance of the note to ensure fast the work is done promptly and also to prevent the company to keep orderly books on each operation. After the 60-day period, the owner will have to pay for the change.

Squad investment plan developed by Don Flower Associates, Inc., Wichita, Kan., is cooperative with the fact that Mooney will provide series of new Mooney Mark 20As a full rate of 6%, which the company has better than any existing lease-lease except for sales of



### Bell 47G-2 Fitted for Missouri Rescue Work

New Bell 47G-2 helicopter, which sells for \$40,500 (NAV Jns. 17, p. 32), has been fitted with later model for Missouri State Highway Patrol by Mississippi Valley Helicopters, Inc., St. Louis partner and charter firm which maintains the service in the patrol and for Illinois Conservation Commission. Mississippi Valley has a Bell 47J Ranger in order

# Materials Memo

Maps of material for the aerospace industry—  
from the 27,000 products of the 3M Company

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## ■ FOR REALLY HOT COPY

Here's a material that the devil himself might use for publication of the *Movie World*. The new document and thermal adhesive paper entitled "Crystal 30" is a completely transparent and fire resistant. Made from a special type of synthetic resin, this

paper has maximum useful temperatures of almost 200°. Visible records placed on Crystal 30 paper have survived the "trial by fire" without loss of the written message.

Crystal 30 is an adhesive that can perform with both versatility and efficiency when the films are used. Depending on the means of application, the temperature involved, the thermal shock may be 65-150° F. or higher. When used as infrared transmitters in film less than 1/8 in. the region of 0 up to 150° F. for a 2 mil sheet, it can easily be applied as a laminate to the surface to be protected. In fact, it is a fire barrier, as well as thermal insulation. Crystal 30 also lends itself to laminating to metal coils or can be vapor coated with metal. Such structures find ready application in tube shields for microwave blankets and drapes, or high temperature tapes. Some emergency designs are simulating it as a temporary material for fire resistant heat machine covers with

new paper covers or a 100% synthetic mesh reinforcement or operating additional reinforcing films may be produced in just ten days to 10 mils. Only papers 3 mils thick are now available for machining. Dry weight of the paper can vary from 0.6 to 1.3.

Other forms of Crystal 30 which are not yet available for ordering are light weight films 1/10 to 20 pound per cubic foot, a binder resin compound molded sheets and finely divided powders.

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pick up and hold the dust. The fabric is designed to resist heat, wear, tear, and abrasion. It is a synthetic, self-healing, self-curing resin. And, since it is self-curing, there are no glue films or edges to worry. There is the fabric only at 100%—but no adhesives or common chemicals which could cause it to be damaged on the dried surface.

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appliance exceeding \$10,000 is value. Particularly noteworthy is a feature that will provide the Money owner with a 30% rebate on his rate if he completes a full year of operation with out claims.

Also, in adjusting damage claims, the money will maintain the right to have the factory repair the appliance with the owner being paid from the factory and requiring that the evaluation pick up the expense at the plant. This system, however, claims will be better than requiring that the customer get the job done for him and perhaps ending in a loss that completely offsets the repair job. According to Flowert, the insurance company will pay charges of insuring damaged aircraft to the better.

Flower emphasized that success of this plan depends upon the factory signing up and those people who fly out will be good risk and ensuring that they get a thorough checkup as the new airplane. He also told dealers that it would be in their best interests to keep track of their customer's habits and if convenient take taking claims to report him to the insurance company.

Flower covered every side of the question, then explained in the U.S., but the company is working on a special arrangement for extending the system outside the country. Such extension would mean with a higher rate than the domestic market.

Richard told Associated Press that current expansion programs planned for the year include a new bid in Seattle building for the Mark II, of approximately 350-400 aircraft. Also, the company will attempt to increase its sales representatives by approximately 10 new distributors and 30 to 50 new dealers this year, while at the same time it expects that dealers will require these sales personnel to serve more than 25%.

The 1969 Mark 204 shows refinements in detail rather than any major changes there. The engine, which has at the factory for \$11,495, now has self-igniting, leading gas induction lights that had been used during the tests to force possibilities of fire in event of windshield breaking, as pointed out during testing. In addition, the new Mark 204 includes a new self-igniting, leading gas induction lights that had been used during the tests to force possibilities of fire in event of windshield breaking, as pointed out during testing. In addition, the new Mark 204 includes a new self-igniting, leading gas induction lights that had been used during the tests to force possibilities of fire in event of windshield breaking, as pointed out during testing.

Trend worldwide is toward equipment on the new Mark 204. The equipment offered with the Mark 204 includes a new self-igniting, leading gas induction lights that had been used during the tests to force possibilities of fire in event of windshield breaking, as pointed out during testing. In addition, the new Mark 204 includes a new self-igniting, leading gas induction lights that had been used during the tests to force possibilities of fire in event of windshield breaking, as pointed out during testing.

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Present applications in the Aviation Industry are: counterweights and weight balances. Applications in other industries include: shielding materials, microelectronics, nuclear power, and many others.

## Is Uranium Shrinkage easy to tolerate?

Uranium Shrinkage may be tolerated and may also be avoided. It may be tolerated by using a material which is resistant to shrinkage, or it may be avoided by using a material which is resistant to shrinkage.

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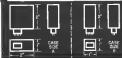
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# U.S. Glider Team to Compete at Cologne

By Russell Hanks

**Los Angeles, Calif.**—Final teaming complete in order to send a team of top U. S. sailplane pilots to the 1959 World Gliding Championships at Cologne, Germany, this June, according to Lloyd Ladner, executive secretary of the Sporting Section of America.

Like other international competitions the championships can be expected to generate odd new variations. U. S. critics in international sports contests were no regular government support and, because of this, sometimes lose touch in subsequent propaganda contests.

American pilots in the 1958 World Gliding Championships were obliged to test European aircraft since they could not afford transportation for U. S. designed sailplanes. Ladner and the only his high hopes of obtaining government assistance in transporting U. S. aircraft to the site.

About 200 companies meet of them in solution will be selected by direct mail in the forthcoming final drive. Several officials hope to raise \$12,500 to pay the expenses of the U. S. team. A similar drive for the 1958 contest raised only \$7,500 and expenses totaled \$8,600.

The difference came out of the pockets of those sailplane pilots. One of the three sailplanes which the U. S. expects to enter in the Potsdam Aeroclub Gliding International sanctioned contest are being designed and built by three pilots, Richard H. Johnson and Richard E. Schrader. Acting as consultant to both was Dr. August Rappert (AW No. 18 1959 p. 99) of Weidmann State University, a top U. S. expert in low speed aerodynamics.

## Five-Time Winner

Johnson, five-time national sailing champion and holder of the world distance record for gliders at 535 mi., now is beginning 1959 flights in his new two-seater, V-42. Adelaide A. Schrader, holder of all three official recorded world speed records for gliders (100, 200 and 300 mi. closed circuit, began construction of his B2-9 mile in December, 1958.

He hopes to parallel his capture of the 1958 National Championships in his B2-9 six months after the beginning of construction. Third U. S. pilot will be Paul Riehl, chief of the National Aeromarine and Space Administration High Speed Test Station at Edwards AFB, Calif. Balle expects to fly a Schwabach 1-33H in the Standard Class competition.

Aircraft in the Standard Class must

be built as a restrictive formula specified by FAI.

A political subject for speculation is whether or not in East Germany team will be entered in a contest held in West Germany. Political issues were involved in Switzerland's boycott of the 1958 World Gliding Championships at Leysin, Poland.

Red Cross is another controversial question mark. Poland is known to be providing technical assistance in a campaign to promote a sailing program there.

A national sailing program could be very useful in Communist China as it is the historic method of providing a cheap training system from which to draw professional pilot candidates.

However, U. S. observers doubt that the campaign has progressed enough to have any pilots of international competition caliber.

## U. S. Haters

A U. S. pilot has won the world

championship only once. Nikolai Gromov, U. S. pilot, won the world championship in 1955. In 1958, the most successful American pilot was Lyle Macey of Denver, Calif., who placed fourth in a field of 57 flying a German Zeppelin II.

Sailing section officials feel strongly about competing in American aircraft.

In a report upon the 1958 championships they said, "In 1960 we hope to be able to fly American sailplanes in the championships. We feel that this is important for two reasons.

- Our pilots will have much more choice of teams.
- It is a point of National pride to be able to show in the rest of the world the type and quality of sailplanes being built in America. We have already established a reputation as a leader in the construction of high-performance, ultralight sailplanes."

## Team Members

Captain of the U. S. team this year will be Paul A. Schuchman, vice president of Selwyn Aircraft Corp., Menlo Park, Calif. He is also president of the U. S. Western Section. Wiggins has been official commentator for 17 years, having accompanied him at El Paso, N. Y., and won the U. S. team membership at three previous world championships.

Most U. S. team members are colored airplanes and will be obliged to use their own team to attend the contest.

It is planned that each American pilot will be offered a three-man ground crew. German Aero-Club, host in the contest has not announced whether the meteorologist, a spare pilot and an aircraft captain will be allowed.



## Atlanta Helicopter Airways Buys Bell 47J

Atlanta (Georgia) Helicopter Airways Inc., began delivery of helicopter younglings at the beginning of this month when the company took delivery of a Bell Model 47J Ranger at Bell Helicopter Corp.'s plant at Ft. Worth, Tex.



Variable Descriptions		Estimate			Mean square			Error sum of squares	
Students	Age in years	Height	EFM	GFM	1000/100	EFM	GFM	1000/100	Student's t (1000)
Fitted Normal Regression for FGM Temperatures in 1987.									
P100	1.28	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P100	1.28	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P40	85	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P40	85	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P40	85	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P10	13.5	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P10	13.5	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
Student's t test (Height) with no increase in Height									
Height	0.00	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0
Height	0.00	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0
Fitted Normal Regression for FGM Temperatures in 1987.									
P100	1.28	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P100	1.28	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P40	85	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P40	85	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P40	85	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P10	13.5	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
P10	13.5	0.1	0.002	0.0	0.000	0.0	0.000	0.0	0.0
Student's t test (Height) with no increase in Height									
Height	0.00	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0
Height	0.00	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0

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FALL 51 **ANALYSIS** BY **WILLIAM S. KATZ** • **REVIEW** BY **JOHN J. HARRIS** • **BOOKS** BY **JOHN J. HARRIS**

**GAZDZIELSTWO** = *patronage, power and control* + *church and clerical hierarchy* + *ecclesiastical organization and integrated subculture* + *local clergy and laicist groups* + *political, cultural, economic and theoretical* + *integrated socio-political system and subculture* + *social relations* + *ecclesiastical organization*



### Cessna 310D Features Lounge Installation

One of the leading arrangements available on the Crown HIND two engine bus is the cost (AW Dec. 28 p. 24) is shown above, featuring a large installation along the left luggage rail. Assembly is standard equipment on all single and dual units.

in extra team members is that he part of the quota of Germans. Because this constraint, the assistant captain and spare pilot have not yet been appointed. Depending on German Aero Club's decision, the U.S. team will number from 15 to 16. German Aero Club will probably allow a maximum of 70 gliders to be entered.

Canadian fighter pilots have even more trouble finding an entry. Thus, since a no-government support and there are fewer large firms able to contribute money. According to private pilots, they will rent aircraft and time, wouldn't go to Cologne as an ex-currency flight organized by the Stearns Society. The exercise not planned mainly for non-competitive spectators from the U.S., so Canadian pilots will have to fly to fly on the practice day. This should be a considerable boarding, since they will be flying in many aircraft.

Prize period will extend from May 19 to June 3. The contest will start June 4 and last through June 17. The two days following the close of competition will be used for the award of prizes and closing ceremony.

Official content control rules frequency will be 122.5 mc. Ground control transmitter will broadcast in English, French and German. Power of airborne transmission is to be limited to 5 watts.

Other frequencies will be allocated for lease arrangements.

World Gliding Championships have never been held in the U.S. European pilots are expected to compete in the

counter-attack of the coalition using weather conditions which has brought so many wild animals to the U.S. However, the members of Boy Scouts officials say that it would be impossible to host such a contest with out full government support. A few suggest that some middle western state like Iowa would be the ideal location for such a contest. Most ranches are set in the interior valleys and mountains of California, but ranch fronts or occasionally push through the mountain passes bringing cattle at a which more can be observed.

This year's championships are the last biennial contests. In the future they will be held on a triennial basis. If the 1964 contest is to be held in the U. S., it will be necessary to apply to IMA about two years in advance.

Three of the top five results in the 1986 open championships were from low-income countries, the Czech Republic, Yugoslavia, Mexico and Polish Judo Z. For this year's championships Schmidt has designed his IFF-S openers for light German through

Johnson's Ministry was an English model system brought to this country from Germany in Dr. Bangs. It is used in the German Phoenix high per-

female amphipod. Aspartic ratio of the Atlantic is 21.3 and gross weight of the two plaits is 990 lb. When floun ratio gross weight is 790 lb. and wing loading is 4.8 psi. It can be flown into to get the best sink rate or glide. Floun ratio is dual to get the best glide ratio. Best sink rate is calculated at 1.65 psi and maximum lift/drag ratio at 44.5.

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K. A. Kellerman, B. J. Goldstein

# DRAMATIC ANSWER TO THE AIR CARGO DILEMMA

Many air carriers, stalling to answer perplexing questions presented by a growing air cargo industry, are facing a basic decision: should they convert automated piston engine passenger equipment and put it on to air cargo routes? Should they order proposed cargo jets with 100,000 lb. pay loads? Should they wait for further turbo fan evolution before making their air cargo plans commitments?

**Canada's Forty Four, offers a simple, practical answer to these vital questions.** It is an optimum size, all-new, all cargo turbo-prop airplane that, in terms of productivity, is vastly superior to converted piston engine equipment, and one that offers, in comparison with the big jets, a payload capacity that is not unreasonably high for profitable operations during the 1960's. Furthermore, the Forty Four suffers little or no operating problems due to runway limitations, and these will be no community noise problems.

The Canada's Forty Four has a productivity two to three times that of converted piston aircraft. At the same cost per airplane mile, and has a profit potential that will quickly recover any losses on disposal of piston engine aircraft now being used or contemplated for cargo usage. On the other hand, the Forty Four with a payload capacity of 65,000 lbs. and low break-even point is ideally matched to the natural expansion of the cargo market and will begin immediately to operate at profitable load factors.

The Canada's Forty Four is flying now and is in production for the three largest air cargo carriers in the United States, and

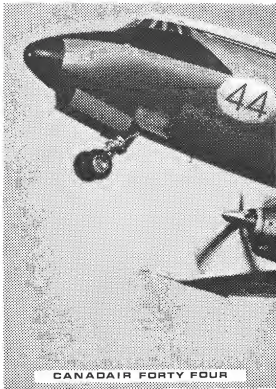
can be introduced into existing fleets as early as January 1967. The Canada's Forty Four can operate in and out of all airports presently used by four engine piston powered aircraft. For example, at such an important airport as Midway, in Chicago, with only 6,100' runways, the Forty Four can take off with 90% of its maximum payload and fly non-stop to San Francisco. Sophisticated design features, including swing tail and integral cargo handling equipment, slash direct and indirect costs. Step-by-step savings and economies inherent in the Canada's Forty Four, combined with its very attractive price, let premium capital dollars work far better return quicker than other "proposed" equipment.

Thus General Dynamics Corporation's Canadian subsidiary, Canadair, the specialist in air cargo, proposes the Forty Four as the answer to air cargo's biggest dilemma.

## Principal Features of the Canada's Forty Four

1. Low prime cost—less than 1/2 the price of proposed jets.
2. Low operating costs—estimated at \$1.35 per aircraft mile, and less than 1/4¢ per ton mile.
3. Right size for the 1960's—its present payload capacity is ideally matched to forecasted requirements.
4. No community noise problems—confirmed during present flight testing.
5. No airport or runway limitations—every major airport open to the Canada's Forty Four.
6. Growth potential—able to grow with the market.
7. Available for delivery in January 1967.

**CANADAIR LIMITED, AERIAL, CANADIAN SUBSIDIARY OF  
GENERAL DYNAMICS CORPORATION**



**CANADAIR FORTY FOUR**

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revolutionary  
inertial  
platform...

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Lacandon alphabet.



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of 2,6-dimethyl-4-*tert*-butyl-phenol  
and 2,6-dimethyl-4-*tert*-butyl-phenol  
were used as monomers. The  
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**Giannini Controls Corporation** 918 East Green Street, Pasadena, California

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

Looking for career openings? Write to Gibson's Director of Technical Personnel

See *Clinton's sexual scandals*. Dating 142B.93. L. B. F. Shaw. New York: Columbia. March 21.04



**GERALD** Kirs indicates heads with seed heads extended at 90 deg. Yield losses damage in off-field landings

## German Kria Glider Built of Synthetics

By Edith Walden

**Germany, Switzerland**—high-speed Kru glider, which made its first flight in 1958 and presently is completing its flight tests, is the second German glider to be made chiefly of light-weight or thermoplastics (AW No. 30 p. 57).

It was designed by Dr Richard Eppley Hermann Nägeli, was a possible for its development and final assembly. Both were members of the Academic Group of Pilon (Akademische Fliegergruppe), a department of the Technical College, Stuttgart. They also belong to the Vöfler-Hirth glider design and construction team which has launched the project Fliegerzeugwerk Hirth GmbH, Nohren/Tek, built the Kru prototype.

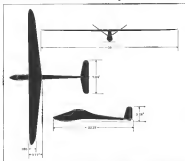
The steel team of glider engineers also developed and built the Knie professor, the first all-plastic FS 24 Phoenix airplane. The Phoenix made its first public appearance in the episode of the German Glider Contest held at Karlsruhe-Friedrichs last summer (AW Aug. 17, p. 179).

### Basic Constructing

Have construction and general appearance of the mouth cavity. Kim is very similar to the Phoenix. Its 70 ft span (Phoenix has a 57 ft span) puts it in the class of gliders which is becoming increasingly popular. One of the main reasons for this is that gliders in this category can easily be moved from place to place, even through narrow, cluttered streets.

The Kwik wings are slightly curved and are transported across the roof of the towing automobile or truck so that very little of the wing surface hangs out over the rear end of the vehicle to offer an obstruction.

Noteworthy is that the supporting surfaces are built in one single unit which reduces the total weight. The company also asserts that failure is a



KEBA's weight is 240 lb. Maximum take rate is 2.10 ip. Polyester resin, glass-reinforced skin covers both wind frame. Chassis is of sandwich construction.



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## Krisa Glider Specifications

Dimensions	
Span	30 ft
Length	12.17 ft
Height	3.15 ft
Wing area	186.31 sq. ft.
Span of all-out	9.64 ft
Depth of glider and	2.62 ft
Root chord	3.77 ft
Tip chord	1.10 ft
Aspect ratio	14.4
Weight and Loading	
Empty weight	275 lb.
Useful load	220 lb.
Performance	
Best glide rate	10
Maximum sinking speed	2.10 ft/s.

not in leaving the ultimate cost. Another special feature is the V-shaped tail section which is of aluminum tubing and also allows the possibility of damage in off-field landings.

Like the Phoenix, the Krisa is made with construction and its polymerized glass fiber reinforced skin covers a hollow wood frame. Attention has been given to making the design as uncomplicated as possible in order to reduce to a minimum the labor cost of construction production costs.

Best glide rate obtained in coast mode was 10 and maximum sinking speed was 2.10 ft/s.

When the Krisa has completed its present series of flight tests including evaluation turn, roll, and lift, it is expected the manufacturer plans to produce a first production run of the glider and to be able to market it at a reasonable price.

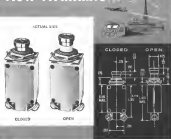
## PRIVATE LINES

Photo mapping of the Midland River valley and surrounding ground support in Thailand, Laos, Vietnam and Cambodia is being handled by Photo pupper Service Corp. Toronto, and Spitzer Air Service using a Douglas DC-7 which carries a radar public recorder for making elevation changes, in addition to camera equipment.

Those for use stock split, increasing authorized capital from \$1.5 million to \$1.5 million common \$1 per share. There are approved by stockholders of Cuyahoga Falls, Ohio, and the new shares being issued March 4.

Kellett Aircraft Corp. will receive flight stability in helicopter under a grant contract from Army Transportation Research Command.

## Now Available



## THE NEW KLIXON Micro-Miniature Circuit Breaker for Aircraft, Radio and Electronic Equipment

These Micro-Miniature Klixon DP104-1 Circuit Breakers are not standards in size, weight and performance. Their fast tripping response provides protection for low electrical power components used in aircraft, radio and electronic gear.

Construction is available for installation in existing panels that accommodate the NAF-104 panel-mounted form or larger semi-mountable miniature open barometer. To give accurate indication (light or buzzer), a normally open auxiliary contact can be provided.

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## NEW AVIATION PRODUCTS



### Pre-Order Designed for Cold Weather

Piston serves a Wright R1575 supercharging engine at Lockheed Aircraft Service, New York. The pistons meet the temperature of 15 gal. of SAE 30 oil from 195 to 200° in 12 min. Oil is delivered at the rate of 10 gal. or variable amounts up to 150 gal. The Wey will supply the equipment to the Aircraft for serving helicopters and aircraft engine repairs. The manufacturer of the pistons, North Hydraulic Corp., says that the unit will tolerate and generate jet engine

### Air Starter Test Stand

Test unit checks efficiency of air turbine starters. Initial delivery are being made in Northrop, SAE and Air India.

The test stand, designed for commercial engine test facilities, weighs a 17 gal., 450 lb. unit. Both an on-board and an external air source are included in the unit. Standard AND 10000, standard, duplicating starter motors on all present commercial engines are used to attach starters. Starter output is accomplished by varying air pressure and temperature. Test unit is mounted on six low base through a 2-in. perf. bracket to four bolts. A 60-cvts per min. transformer for conversion to a factory speed converter is

being furnished with the test unit. Air Research, Inc., Division, 402 S. 16th St., Phoenix, Ariz.

### Liquid Oxygen Trailer

Seed-trailer for transporting liquid oxygen, liquid nitrogen or liquid argon has a capacity of 4,800 gal. Trailer, developed for the Air Force to meet MIL-S-20796A, are insulated to meet specification limit to 1 lb. per day. The trailer consists of a double-walled stainless steel tank mounted on a tandem axle railway trailer equipped with air brakes. Liquid oxygen is transferred by means of two 24-in. dia., 20-ft. long hoses. The trailer measures 14 ft. 6 in. in length, 8 ft. wide and 10 ft.

high, gross weight is 65,750 lb. Max. tank pressure is 100 psi. Laclede Co., 30 E. 42nd St., New York.

### Miniature Free Gyro

Members two are free gyroscope for remote guidance applications to length less than 21 lb. and maximum 4 in. x 2.75 in. diameter.

Mechanical coupling of the H17 gyro is actuated by a pulsed pneumatic cylinder, externally through the gyro base. When the plunger is depressed, the pulsed vacuum cupped and electrically energized. Both pulsed can be energized simultaneously to less than 0.1 sec. (24 to 30 v d.c.). Specifications include: range meter gimbals, 360 deg. zero gimbals plus or minus 150 deg. from cupped position; defl. 8° deg. per min. average vibration 20 to 300 cps. (15 plus or minus 12) to 1,000 cps. (10 plus or minus 12). The gyro will operate over a temperature range of -54 to +70°C.

Glenair Controls Corp., 918 E. Green St., Pasadena, Calif.

### Exploding Bridgewire Detonator

Exploding bridgewire system forms nuclear motor initiation, remote control, squibless, direct initiation, reliable, compact, upon command and other ordnance functions.

A high energy pulse, generated by a special bridge unit in the ordnance, is used to explode the bridgewire. The nature of the pulse required to explode the wire makes the system immune to premature initiation caused by low d.c. voltage potentials in the ordnance and to high-frequency radio frequency fields. The exploding bridgewire detonation system is used for positive initiation safety and reliability than better electrochemical wiring mechanisms.

Lithonac, Inc., 676 Airport Ave., Sunnyvale, Calif.

### Thermal Insulation Paper

Insurgent, foam-encased paper generated from synthetic resin are being used to duct and honeycomb structure to provide thermal insulation in aircraft, missiles, Motors, called Control M, can be in sheets from 9.5 to 17.5 grams in its uniting point is 1,900° if heated in a closed system but converts to a higher melting ceramic body when heated in an open system. Depending upon the temperature involved and the method of application, the thermal "R" can be 0.5 to 1.5 Btu in. sq. ft./hr./°F. The reduced resistance is less than 10% in range of 0.15 to 0.25 in. sq. ft. per inch. Monomax Molding and Manufacturing Co., Dept. 59-403, St. Paul 6.

## Jet Ejectors Studied For Vertical Takeoff

New York—Thrust augmentation for vertical takeoff by means of jet ejectors is being studied by Lockheed Aircraft under Army contract. The ejector propulsion system is proposed for an Army helicopter, aircraft which would require V-12, capabilities, a higher velocity than that attainable with other jet propulsion vehicles and good low altitude performance.

The ejector principle was chosen as an effective means of providing sufficient thrust, thrust without increasing the weight for more requirements. The jet ejector uses a mixing chamber and a diffuser to create acceleration and to decrease the velocity of the gases. The ejector is a three-stage ejector at low speed which may be used to provide the aircraft during vertical flight. Cruise power is obtained from direct jet engine thrust.

Lockheed is doing a thrust ejector test on ground. In the F-100 is thrust jet engine with two parallel ejectors. The test points require that the performance of the 1,000 ft. test jet power the feasibility of the concept.

The test jet's 144 talpans extend forward on two parallel ejectors, each



### Boeing-Wichita Laboratory for Hazardous Tests

Boeing Aircraft Co. has developed a laboratory for hazardous tests at its powerplant test center, Wichita, Kan. The powerplant test chamber (designated) has a range of -100° to 250°. Other facilities include an electrostatic chamber which can simulate 70,000 v. static and -50° to 250° temperatures, and salt spray and dust chamber

equipped with 20 pairs of different nozzles on the lower side. Ground effect studies indicated a reduction in thrust of a single engine in the distance approached the ground plane. The use of parallel engine eliminates this problem.

Ground effects of the Lockheed

VTOL device, described at the annual meeting of the Institute of the Aeronautical Sciences in New York, result in a magnitude of 85% augmentation at a height of 15 ft. The ground effects are best in the test jet nozzles through a height of 5 ft.

The ground effect of the engine jet

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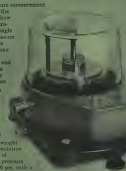
For solutions to pressure measurement problems, depend on the experience and know-how of Consolidated Electro-dynamics—the only single source for all your pressure instrumentation needs. The integrated CEC line ranges from rugged transducers, readouts, and other related precision equipment to primary calibration instruments.

Accuracy begins with CMC's G-201 Primary Pressure Standard, a calibration instrument used to ensure the accuracy of pressure measurement devices.

This pneumatic dead weight action gauge offers a resolution of better than 0.005% of reading... covers six pressure ranges from 15 to 550 psi, with a minimum pressure of 0.3. It achieves accuracy that is conservatively rated at ±0.15% of full scale in pressure ranges to 550 psi and at ±0.025% of full scale in pressure ranges of 150 to 550 psi.

The 6-201 is a true primary standard that defines mass, length and time for its reference. Its accuracy depends only upon the dimensional accuracy of its component parts. Write for Bulletin C-201 L187-X22 for detailed specifications.

For complete information on CEC pressure instrumentation and pressure measurement devices, send today for Balluff CEC 1308-M12.



### Compass Calibrator

Protonics Inc., a company called a "non-invasive," checks out 50% of earth's horizontal magnetic field and produces a vertical field which can be adjusted through 360 deg. in seconds. Device was developed by General Electric Instrument Dept. for AEC but is expected to have commercial application for subsiding geosynclinal basins. This device is far less expensive than conventional Helmholtz coil system formerly used. GEF sees.

is described as low for a VICE, no cough. At 20 ft from the side of the stream the air velocity is 35 fpm and the temperature is 162°F. Personnel may walk to the side of the rig while it is hawking, and the noise level recorded at 20 ft. is 115 db.

The test device, originally fitted only with a pilot seat, has been modified to permit visitors to ride the VTOL rig. Development problems at the reactor augmented VTOL rig included roll control and recognition of hot gases. The reliability of the device is deemed to be excellent with no failures during the 18-month test program.

### B-58 Escape Capsule Uses Gas Generator

Fl. Worth, Tex.—An end-rotor-type escape capsule for the Cessna B-17 Bonnier being developed by Stanley Aviation Co. will incorporate dual gas generators to power the capsule's ejection sequence, allowing ejection to be delayed to the maximum time.

If a handler becomes involved in pre-flight activities in anticipation of leaving the aircraft, there tends to be confusion with the plane and even stress to small aircraft preparation and air conditioning system, he can do it safely since the second gas generator is available if he has to exit later.

The Hunter capsule, which has auto-stable flight characteristics to limit tumbling at high speeds and altitudes

as well as a passivate recovery system, but provisions for absorbing water leading shock loads and corrosion stabilization and flotation gear to keep the capsule afloat in the water for at least three days. Flotation toys were scheduled at Matichichal Point, Choson, Ohio, on Lake Erie, with a dummy riding the capsule, and a human volunteer later added for three days.

Pro-competitor response for the Harvard squash has the crossman pulling a mechanical trigger to start the gas (oxygenator, developed by McCormick Sulphur Associates, each of which weighs 34 lb. or 7 lb. per capsule). Gas from the gas station drives an actuator system which lifts the crossman's knees up against his chest and simultaneously stretches his feet against the forward edge of the seat. Both actuators act on struts which push the individual's torso forward back, locking his body and head against the seat.

When these two operations are complete, other capsule components lower the three canopy doors into position around the crevasse and prepare for the capsule touchdown.

Here the crowman can decide whether to go or stay if he stays in the capsule, he can operate all necessary controls from within the capsule to continue the flight and complete the mission. If he opens the capsule and returns to airplane presentation and air conditioning systems, he still can go through the pre-flight sequence once more, after which he either has to quit, keep the capsule pressurized for the rest of the flight, or if he again decompresses the capsule, he has to complete the flight using survival means.

Time from initiation of the McCoy with Sulph gas generator until the perception sequence is completed and overview is ready to report images from 0.5 to 0.8 sec.

## Spherical Bearing Has Segmented Ring

**New York**—Extended spherical bearing life under severe vibration, temperature and load conditions at aircraft and marine applications is indicated by tests of a segmented ring withsliding spherical bearing.

The bearing, called South/sing, is in production at the Aerospace Bearing Co. in South Bearing Division, Newell, N.J. Aircraft applications for self-aligning bearings include landing gear, it rotating wheels, engine mounts and control linkages.

Model applications include electro-hydraulic actuators in guidance systems and attitude control systems for spacecraft. The South bearing is intended for applications where severe load and vibration, both at low transmission and

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4703 SON PRESSURE BALANCE

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quite more stable than larger  
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response shows that's easier to  
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SMITH/ALLEN bearing separator at V joints, each segment clings to the splines

ending problems and where reliability is of prime importance.

The unusual feature of the bearing is the two-piece ring separated at V joints. Each segment actually extends more than halfway around the ball so that each segment clings independently to the ball. Neither of the attached segments can separate from the ball under normal operation. The bearing is assembled by positioning the ball so that it is 90 deg. in its normal operating position in its case. Rotating the ball into operating position locks the bearing together and it is ready for insertion in place.

This self locking segmented ring design permits the use of hardened outer rings with full bearing areas. The fitted

joining surfaces where the ring segments meet are precision ground with polished edges to avoid scratching the ball. Special oil films may be supplied for the ring when needed.

The bearing assembly illustrated, for a high temperature application, has no lubrication provisions. Smith says, however, that grease grooves can be provided inside or outside the rings. Lubrication access to the inner grease groove is provided by filtering the points of the V joints creating a clean seal to the inner ring. Lubrication to the ball also may be provided.

In addition to the manufacturer's tests, samples of the bearings have been sent to various service companies. Smith, on the basis of ground force



## VOUGHT TAKES AIM AT THE SUBMARINE

Submariners, submarines and sub-assembled missiles are automatic foes of a special ASW department at Chance Vought.

Vought's ASW team, drawing on a two-year backlog of comprehensive submarine experience, is working with the Navy and its Fleet units to develop advanced means of protection against attack from under the sea.

For the past ten years, Vought engineers have crisscrossed around Europe in pioneering voyages. They have learned the ways and habits of submarines. The company now is applying this valuable insight into virtually every phase of submarine warfare.

Vought's program in ASW work is based on the application of concepts heretofore unused in the field. A superior sonobuoy has been developed. A long-range investigation of the use of satellites in submarine detection is under way. And entirely new techniques in the use of current and buoyage... aircraft systems are being explored with the purpose of achieving a complete antisubmarine defense.

In order to test the equipment and techniques under development for the Navy, Fleet submarines and aircraft will be operated for Vought under a broad variety of environmental conditions. Vought's engineering design and manufacturing teams can be counted on to handle these new concepts into effective defense systems, in whatever direction ASW leads.

Antisubmarine warfare, along with atmospheric missile and piloted aircraft development, are specialties in Vought's Aerospace Division. Other major interests are being aggressively advanced in the company's Automotive, Electronic, Range Systems, and Research Divisions.

**CHANCE Vought**  
Aircraft Division

AERIALION WEEK February 12, 1962



## SALT WATER SHELL GAME

Find the sub. It is somewhere in the ocean lanes that cover 70 per cent of the earth's surface. Learn its movements. Find the key that is lost in the din of waves. Keep the sub at a safe distance. With one of its nuclear missiles, it can destroy any U. S. city. Don't be deceived by a single provocation... an estimated 450

nuclear missiles need watching, too. So go the steps in one of history's toughest defense problems. So run the routine should Navy ships and planes sound-the-dock work reinforced by the efforts of American industry and ingenuity to provide the equipment needed to cut the Five World's biggest menace down to size.



**CHANCE Vought**  
Aircraft Division



## Transporter-Erector Developed for Rocket Engines

Transporter, weighing 55 tons, is capable of handling solid or liquid rocket engine units up to 15 ft. long, 45 in. in diameter and weighing 80,000 lb. The equipment will be used to transport rocket engines to test firing sites and to place them in horizontal or vertical position for static test. The transporter is built by the Method Division of Hughes Corp. under \$725,000 contract from the Thiel Chemical Corp.



CORNING MODEL JEC-10



MILITARY MODEL JEC-8



STATIONARY TEST UNIT

## MAXIM TAMES JET ROAR

With over fifty years of leadership in noise suppression, Maxam has the engineering know-how that assures you of getting jet silencers of the highest reliability. Maxam Jet Silencers, both portable and stationary, have distinct advantages that merit investigating.

**E**ngineering Manufacturing Company  
Maxam Division/Dept. 70  
Box 576, Hawthill 1 Cincinnati

side repairs, is pending the air-bearing rig on standard size. The chief advantage of the suspended ring bearing benefit was in the controlled position which can be built into the fit of the bearing ball with the matched ring, all pointed and polished as a unit. Such inspection of the finished product also is vital as an advantage. The lighter cost of the freely tilting bearing will limit on the critical applications where reliability and long life are needed.



### U.S., Australian Ground Cushion Vehicles

Fourth Ave. Glider-Mobile (later) with superior Glider Piloter of Sports N. 1, at the controls is a new ground cushion vehicle that has successfully, from 4 to 6 in. all the world. Unit weighs 240 lb. and is powered by a 72 hp. McCulloch's engine which runs at 50 in. the propeller. Flashes in Rotomax Motors engines, are the air will travel at about 20 mph on a smooth flat, carrying one crew. Control is achieved through push rods. Below a motorized ground cushion vehicle, the Rotomobile, test runs at Adelaide, Australia by its creator, Harold Glider. Machine is 7 ft. in diameter and weighs 160 lb. Glider is working in the cockpit. Powerplant is a 30 hp. motor; propulsion system during a 2 ft. in. air-cushion propeller. Machine can run 6 in. without pilot control at present is tested, ground through grass, although motor direction control is achieved by hand.



### Gross Weight Rise Sought For Lodestar With JATO

Lodestar Lodestar, authorized a total gross weight of 19,000 lb. using 1,500 hp. Can-Am-Wright engines and 18,500 lb. with JATO bottles installed, is expected to mean an authorization to increase maximum takeoff gross weight to 21,500 lb. with the JATO bottles.



### BLONE DESIGN

Rotative M-D 3-blade design adds strength—weight  
Istair: Symmetrical flow—  
more power—higher speed  
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M-D blowers operate at wider pressure and speed ranges than any other rotary positive blower. Capacities of 22 production models range from 30 to 4,000 CFM, pressures to 14 PSIG single, 70 PSIG multi-stage.



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### PRODUCTION BRIEFING

Air France expects to take delivery of 15 Sud Aviation Caravelle jet transports during 1965, thus completing its fleet of 24 Caravelles. The French carrier already owns 12 Superjets capable with its 1970 Caravelle deliveries. By the end of 1960 Air France will be operating the Caravelle on 60 routes serving most major cities in Europe, North Africa and the Middle East.

Austron Airlines has signed a contract to buy an Avions Voisins 187 twin-engine turboprop, a total of 415. The contract calls for four to be delivered by Aug. 1.

Texas Instruments Inc.'s Acoustics Division secured a \$4.5 million contract for advanced, non-electronic sonar system from Navy Bureau of Weapons. Delivery of the system will begin in 1965.

Japanese Guided Missile Control will send a 10-member survey mission to the U.S. and Europe in March to report manufacturing processes and operational status of various weapons. Mission is headed by Yoshinori Seki, president of Mitsubishi Electric.

North American Aviation will build 55 additional F-105 interceptors from jet engines for U.S. Air Force, commencing to 42 the total production order. So will be fitted with all weather search and range radar (ANASARL) manufactured by Autonetics Division, for The North American police training.

Perkins Engine & Turbine Corp. is constructing in addition to its Plants Branch at Casagosa, N.Y., which will provide 12,500 sq. ft. of additional space. The expansion, to be completed next month, will provide more area for production of enclosed plastic items in water-soluble plastic dishes. Titan ICBM components and solid rocket engines.

General Dynamics of General Dynamics Corp. will install nine F-105 test stands to produce ready all-weather interceptors under an \$8 million contract from Sea Airborne Air Materiel Area, and will purchase long lead time items for modification of another 26 F-105s. Purchase for operating total of 35 F-105s will cost about \$20 million.

Army Ballistic Missile Agency has received a \$1.5 million contract for 100 space heaters from development site at Redstone Arsenal, Ala. to Cape Canaveral, Fla. Delivery of the vessel, 100 ft. long with a displacement of 450 tons, is scheduled for late 1960. Buys will be propelled by a tagout.

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**VERTOL YHC-1B**, with a maximum gross weight of 35,000 lb., is 51 ft. in length, 12 ft. 5 in. in width, and 15 ft. 6 in. in height. Overall length, blades unfolded (full diameter of both rotors) is 90 ft. 2 in. Average cruise speed is 130 kt.

## First Design Details of Vertol YHC-1B

By Robert L. Steinfield

Muscon, Pa.—First design details of Vertol's tandem rotor turbine-powered YHC-1B Chinook, an Army battlefield mobility vehicle now in modular form, point to a medium transport helicopter with a maximum gross weight estimate of two tons (interim payload) and a maximum alternate gross weight estimate of close to eight tons (interim payload). Top speed is specified as 132 kt.; cruise speed, 130 kt.

Chinook design was aimed at simplicity and ease of maintenance. The objective is a helicopter that can be maintained at organizational level by a technician relying solely on a standard U.S. Army tool box. It will also have all-weather, day-night flight capability.

Powerplants, selected by the Army, will be two Lycoming YF554-5 three turbine engines (AW May 15, 1979, p. 42) with a delivery rating of 1,946 shp each, and which are programmed up to 2,100 shp day duty of each engine to 383 ft. The retrofit can absorb the full power of both engines at sea level on a standard day, according to Vertol.

The YHC-1B will be used by the Army as a means of transport for personnel, weapons and cargo in both combat and non-combat. The cabin configuration is compatible with the Army family of vehicles that carry troops in bulk. The cabin is 78 in. high, with an upper corner radius measure of 45.5 in. Width is 90 in. length, from main fuselage to far wing bulkhead, is 50 ft. The constant cross-section fuselage can be easily expanded in length.

### Chinook Cabin

Cabin includes provisions for 32 troops with 28 sq. ft. space per man, plus troop commander in the jump seat, or 27 paratroopers with 24 sq. ft. of space per man. Support structure will mount 24 litters. The Chinook also has multiple applicability, it can carry all components of the landing system (though not all in one load).

Initial Army order for five Chinooks, placed through USAF's Air Materiel Command, was in March, 1959. Service is programmed for five more, with money set aside out of Fiscal 1960 funds. In-

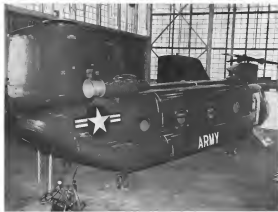
ital AMC contract, AF70007-70492, was for \$28 million. Fixed landing designed for high production is now under way at Vertol's Muscon plant. The first YHC-1B is scheduled to roll out this November, but the initial five the following April. First flight will be early in 1961.

Additional design features of the Chinook, as stressed by Vertol, include:

- Rear landing ramp which can be left open or partially opened, or can be moved for flight. This permits transferring of extra-length cargo internally, and facilitates in-flight pendulum or free-fall delivery for specialized missions. Ramp is designed in a way, plus form and can be adapted to any required height.

- Telescopic mast, compatible with Navy carrier operations as well as with USAF and Army operations. Design features, said not to penalize the Army version, include blade flap enhancers on rotor blades for high-speed carrier operations, landing provisions (will partially retract) at all landing gear, far longer deck element, provisions for amphibious operations in accordance

## AERONAUTICAL ENGINEERING



**CHINOOK** shown at high on the surface to allow for landings in bays. For carrier head helicopters, the overoff height can be reduced to 87 ft. for longer deck moorage by partial extension (folding) of the air sighting arm.

with Navy requirements (in emergency present Army version will float).

- Fuelage is sealed in production, the helicopter is completely integrated for all-weather operation, including wind-shield, main blade and engine inlet design. Flight instrumentation includes independent dual flight controls.

- Auxiliary power unit is capable of operating all hydraulic and electrical system with rotor blades stopped. The APU also will provide power to start engines down to -65F ambient.

- Mainmast duff, to make the helicopter self-supporting and eliminate the need for special winchstands, has been designed for the YHC-1B. The duff parts weigh about 140 lb., though production models will be lighter. Designed to take 1,700 lb. of weight, made transportable in the helicopter, the duff is capable of removing rotor hubs, transmissions and engines, and can be handled by three men. The big gear sight them, the beam and upper part of the duff, weighs 190 lb.

- Coolings, doors, etc. of the Chinook.



**YHC-1B** powerplant are (overhead mounted). Work platform is push possible access to engine. A hoist system permits arriving without removal of the engine.





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**CHIMDIE** (left), designed to take 1,500 lb. of weight in torque of rotating rotor hubs, transmission and output, and can be handled by three men. Forward rotor hub (right) is secured from integral work platform hinged in the pylon.



**EXTERNAL** cargo hook (left), hydraulically actuated, is capable of suspending eight tons. Forward rotor hub (right) is secured from integral work platform hinged in the pylon.

plant can be removed without disassembly.

The forward rotor hub and the upper forward controls, including two hydraulic actuators, are serviced from integral work platforms through the two hinged channels in the forward pylon. The aft rotor hub and aft upper controls, including two dual hydraulic actuators, are serviced through the access ladders from integral work platforms in the aft pylon.

Daily greasing of the rotor hub and upper controls has been eliminated with all large bearings and the sealplate bearing are completely

submerged in oil at all times. Oil levels of main units are determined from sight gauges.

### Airframe Details

Chimdie's forward loading section is completely fabricated and assembled prior to shipping to the cabin section. One compartment incorporates stowable doors for both pilot and copilot. The main entry door, on the right side, is composed of an upper hinged section which may be opened in flight and a lower section with integral steps that opens out and down. This section 20 x 40 in., is jettisonable.

Cabin loading consists of four panels, the upper, left and right side and the bottom. The lower section, when covered by the external magazines in cargo floor, forms a series of watertight compartments. For emergency water landings, the bottom door and the cargo floor are sealed.

The floor is designed for a distributed load of 150 psi and a concentrated load of 3,000 lb. per wheel in the water section. Outboard portion of the floor (aka threshold) is designed for a 2,500 lb. wheel load. Floor contains 84 5,000-psi hydraulic fittings and eight 18,000-psi fittings. There are also four









## Fire Control by SPERRY

When the Navy's first nuclear-powered surface ship—the USS LONG BEACH—joins the fleet, she will have a cruise capability of better than 30 knots, with virtually unlimited range, and she will be armed with the sea force—air Talos and Terrier missiles. The most advanced ship of her kind, the "CON-9" will have the most advanced shipboard missile control equipment: Sperry.

Forward, Sperry SPG-35 missile-guidance radar directs the Terrier missile. Aft, Sperry SPG-45 super-radar

controls the longer range Talos missile. Amidships, and at the protected bow deck region, are the brains of the system, the computer complex. The Sperry Weapon Detection Equipment (WDE) evaluates target threat and decides which missile to fire at the selected target. The Sperry Mk 111 computer tracks target position data from the SPG-45, calculates the best missile-to-target flight path, and positions the guidance beam generated by the Sperry SPW-2 Radar. Then it calculates "kills."

With her combination of speed, range, firepower, and advanced Sperry fire control and weapon equipment, the *Long Beach* will make a formidable argument for peace when she joins the fleet.

**SPERRY**

SURFACE ARMAMENT DIVISION, SPERRY RANDOLPH COMPANY DIVISION OF SPERRY RAND CORPORATION, GREAT NECK, NEW YORK



## General Electric Designs Nuclear Engine Starter

Test photo of a 530 hp, 214 lb. induction starter and motor developed for an aircraft engine powered by General Electric's Aircraft Auxiliary Turbine. Permanent power and heavy machinery to self-starting speed in 10 sec. and begin 4000 rpm (working) during powerplant cooling period at shutdown.

all the forward rotor loads in the structure.

The air transmission is mounted on four mounting legs of the upper transmission cover. The air pulley housing is oil (pressure) lubricated, not greased.

### Drive Shifting

Drive shifting is composed of interchangeable sections of aluminum tubing connected by levered, flexible, stainless steel coupling, and is supported by press lubricated ball bearings isolated from the engine structure. Forward and aft transmissions have a wet coupling system with an operating pressure of 90 psi. Combining gear box and engine gear boxes have a complete and independent oil circulation system.

Fuel system consists of two open vent fuel tanks located in external pods attached to the wingline area. Total fuel capacity is 618 gal. Tanks are pressurized at 280 psi, and ground refueled at 30 gpm. System can be operated up to 6,000 ft without boost pumps. Fuel can be fed to either or both engines from either or both tanks.

Auxiliary power unit is a gas turbine engine developing 75 hp, at an inlet temperature of 125 ft. Dry weight is 50 lb. A 1,000 psi hydraulic motor/pump, driven directly from the power take-off, provides hydraulic power for APU starting, main engine starting and stationary gearbox drive for equipment checked with engines and rotor shaft.

down. 510C 18 rotor blades have a radius of 29.5 ft. and a total blade chord of 21 in.

Axial is a modified NACA0012. The blade has a 9 deg twist and a solidity ratio of 0.607 at the rotor disk. Blade is attached to the hub at the vertical hinge by a vertical hinge pin. The pin is tapered fitted with the blade which threads onto the root end of the blade.

The blade design attachment is an integral part of the sector.

Chemical clearing system is incorporated into the blade. The centrifugal force of the rotating blade drives a wad of wet, glycerine and alcohol from a sump ring mounted around the rotor shaft.

### Rotor Head

The rotor head is a fully articulated assembly containing horizontal, vertical and pitch hinges, which allow each blade to flap, lead lag and pitch (twist). The hinges are mounted at the rotor shaft and the leading hinges are forward at the blade root and pitch hinges are located between these two points.

A self-contained hydraulic damping system for lowering the leading edge is connected to the trailing edge of the blade span and the pitch housing. All rotor bearings are completely submerged in oil at all times.

Only four of the five blades require folding. Manual folding is accom-

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Aircraft manufacturers' Company Chemicals warehouses by utilizing most shipboard inventory systems where pre-packed and pre-packed packages are needed to individual customers.

"Drug shipments need expensive refrigerated warehousing and special handling as a rule," comments W. F. Mackay, Transportation Manager, "Westlake's" the requirement by using Delta Air Freight and some of our business (over and over). A 10-ton shipment, for example, can be flown to Atlanta where individual packages, already pre-packed and stamped, can be sent to our customers in a fraction of the former time."

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**Constant Voltage Module**—Uses zero-drift and an induced temperature compensation to replace standardizing mechanism.



**Measuring Circuit Module**—Contains ready-changed range switch, range and zero-adjustment. Range is changed simply by replacing zero-drift pieces of fixed resistors.



**Amplifier Module**—Quick-connect design permits fast, easy removal for servicing and replacement. Circle shows quick channel plug.



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plished by depressing the rotor, rotating pin to lock pin, and unlatching the blade. Diagrams with a built-in, quick-release mechanism. All folded blades are within the maximum width of the fuselage.

A hydraulically-actuated external cargo hook, capable of suspending eight tons, is furnished at the nose hatch. It can be controlled either by the pilot or a man at the hatch. The hook is mounted on a carriage and travels laterally on a curved beam so that the line

of action intersects the centerline of the helicopter slightly below its center of gravity, thus providing cushion on lateral stability and cushioning the rolling movement created by a moving load.

Cargo handling and rescue hoist system evolved around a utility winch designed to produce 3,000 lb. cable pull at 20 fpm. for cargo loading, or 600 lb. cable pull at 100 fpm. for rescue operations.

Winch is powered by a hydraulic motor and incorporates a braking de-



### Convair 600 Anti-Shock Bodies, Slots Detailed

Aerodynamic air shock bodies for Convair 600 jet transport wings (AW Feb. 8, p. 48) are shown in working lines (above). They are attached to upper surface of each wing to eliminate surface and wet drag. Inboard bodies are 23 ft. 10 in. long and 46 in. wide, each holds 150 gal. of fuel and carburetor fuel. Outboard bodies are 23 ft. 10 in. long and 46 in. wide, each holds 150 gal. of fuel and carburetor fuel. The photo (see line 48).



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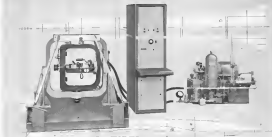
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Available separately as a complete unit is the Three-Axis Flight Simulator, this Altitude Simulator reproduces dynamic altitude changes through a bandwidth of 0.700 feet with a frequency response of 12 cps. Operating range at sea level is 0.500 feet.



FIGURE 1: Complete system for a dynamic altitude simulator.

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1000 which stops the wheels before a suggested load can bank the rifle.

For cruise operations the cable is reeled upward just out of cockpit, taken along the ceiling to the motor bolls, then lowered down through the bolls. Pulley block directly over the bolls is equipped with a cable cutter for emergency operations.

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The flight control system is a dual redundancy system provided by two hydraulic actuators located immediately below each cockpit. The failure of one will not effect pilot's controls in aircraft stability. All components of the control system are accessible for servicing in zero-gravity conditions.

The two flight control hydraulic actuators are Type 1, 5000 psi, systems with a maximum flow of 57 gpm. Each actuator has its own emergency, manual and pump. One system power on the upper dual actuators in each side head and the stick boost actuators. The other system power the remaining upper dual actuators and the available magnetostrictive strain rateable bolls. Failure of one system will not cause excessive cockpit control loads.

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The ability hydraulic system powers the wheel and motor brakes, the motor and landing wheels and bolls, the cargo ramp, and also provides power for main engine, auxiliary power and steering.

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Falls Church, Va., is a wholly-owned subsidiary Deconette, which engages in and manufactures products, including decontamination, for the gas processing field, employs about 50 persons. It will continue to operate its existing production and technical management. Administrative responsibilities for Deconette will be assumed by Process 5 Share, head of Atlantic Research's Solid Threepoint Division. The acquisition involved an exchange of Atlantic Research stock for Deconette stock owned by the Deconette management group. Atlantic Research recently acquired Insley & Butler, Inc., Washington, D.C., Process Aircraft Co., Philadelphia, A. M. Martin Co., Pasadena, Calif.

### Financial Briefs

**Ydercom Corp.**, Los Angeles, reports record net earnings of \$3,847,552 on record sales of \$38,831,194 for the fiscal year ended Nov. 1, compared with fiscal 1988 net earnings of \$445,777 on sales of \$29,496,049. Per-share earnings in fiscal 1989 were 71 cents on an average of 2,672,000 common shares, compared with 12 cents on an average of 2,556,115 common shares outstanding in the previous year. Company's backlog was \$27,915,000 on Nov. 1, compared with \$22,518,000 on Nov. 3, 1988.

**Altair Corp.**, El Segundo, Calif., net sales for the first fiscal quarter ended Nov. 30 was \$2,837,779, compared with \$4,463,970 for the corresponding period in fiscal 1988. Net profit for the fiscal 1989 quarter was \$36,796; the company recorded a net loss of \$173,694 in the corresponding fiscal 1988 quarter.

**Varian Associates** reported record sales of \$10,477,131 for the first quarter ended Jan. 31, up 30% from sales of \$8,197,795 recorded in the first fiscal 1989 quarter. Net income for the first fiscal 1990 quarter was \$757,773 or 18 cents a share on \$3,930,463 shares outstanding, compared with \$574,479 or 17 cents a share on 3,111,112 shares for the corresponding period last year. Backlog as Jan. 31 was \$25,104,000, it was \$19,815,000 a year earlier.

**Moog Instruments, Inc.**, sales for the calendar year 1988 totaled \$1,201,000, compared with sales of \$3,692,000 for calendar 1988.

**Acmet-General Corp.**, a subsidiary of General Tire & Rubber Co., reports sales for the fiscal year ended Nov. 30 totaled \$164,401,300, or 67% more than fiscal 1988 sales of \$123,753,381. Earnings after taxes for fiscal 1989 were \$8,203,328, they were \$6,027,827 at the end of the previous fiscal year.

**Assensus Research and Development Corp.**, venture capital company of Boston, will risk stockholders to support, at an annual meeting Mar. 2, a proposal to increase authorized shares and then elect a threshold vote right of authorized shares. Company's net assets on Dec. 31, after deducting a distribution of \$1.90 a share, were \$31,478,278, at \$99.90 a share on 995,000 shares outstanding. Net assets were \$14,795,599 at the end of 1988.

**Chance Vought Aircraft** has signed an agreement to acquire an 80% interest in Information Systems, Inc., St. Louis, Ill., expanding the firm's holdings in the automation field. To run, Information Systems is acquiring operating assets of Profitis, Inc., originally its parent company. Genesis Corp., wholly-owned Chance Vought subsidiary, and Profitis will become separate operating units of Information Systems, which will be a separate subsidiary from Chance Vought's new mobile business subsidiary, Vought Industries, Inc. (AW Feb. 1, p. 27).

**North American Aviation** earnings for the first quarter of fiscal 1989 were \$5,992,000 (74 cents per share), an increase of \$60,000 and a cent per share over a like period a year ago. Quarter sales totaled \$164,668,599, up \$99,398,108 over sales a year ago. Company backlog at \$670,704,500, against \$422 million for last year's opening quarter.

**Bunker Corp.**, Danbury, Conn., sales of precision ball bearings, reported record net earnings of \$1,215,192 or \$1.69 a share on 718,933 shares for 1989, compared with net earnings of \$648,419 or 90 cents a share on the same number of shares in fiscal 1988. Sales for fiscal 1989 were a record \$12,811,945 compared with \$8,378,107 in the previous fiscal year. The company recently acquired a private placement of \$2 million in 14% convertible subordinated notes due Dec. 1, 1975, with semiannual interest.

**Sigbee Corp.**, net income for the first quarter ended Dec. 31 was \$3,736,870, at \$1.97 a share on 1,699,603 common shares outstanding, compared with \$1,251,660 or 90 cents a share on 1,598,171 shares in the last half of 1988. Sales for the 1989 quarter total \$45,029,831, they were \$41,067,799 at the end of the last six months of 1988.

**Allegheny Ludlum Steel Corp.**, net earnings for 1988 were \$11,790,664 or \$3.82 a share on 3,060,854 common shares compared with \$5,844,903 or \$1.52 a share on 3,878,008 shares for 1988. Sales for 1989 were \$230,564,640, up 14% from 1988 sales of \$201,715,284.

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400-600 g's, three phase  
600-800 g's, three phase  
800-1000 g's, three phase

Construction  
300-400 g's, three phase  
400-600 g's, three phase  
600-800 g's, three phase  
800-1000 g's, three phase

Performance Characteristics  
Per Axis  
100-200 g's, three phase  
200-400 g's, three phase  
400-600 g's, three phase  
600-800 g's, three phase

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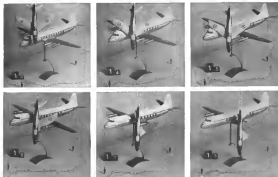
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**GENERAL PRECISION**

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## SAFETY



ITALIAN accident investigators have reconstructed the Viscount F562's mid-air collision with the noted diplo-

### Italian Accident Investigation Report

## BEA Viscount Flew Into Prohibited Area

(Following is a report to the British Ministry of Transport from the Italian Ministry of Defense on an inquiry into a mid-air collision between British European Airways Viscount 701 G-ANIG and an Italian air force North American F 562 jet fighter, Oct. 21, 1955. The report has been translated from Italian.)

### SUMMARY

The Viscount, coming from London and bound for Naples, 8700 ft. North American No. 1, reported at 1144 ft. flight over Gela at 25,000 ft., stating that it was continuing to Porto and claiming that it would be over Porto at 1157 ft.

The collision with an Italian jet fighter aircraft, bearing part of a fuselage on a training flight, occurred at approximately 1150 ft. east of Nettuno. Killed were 35 passengers and five members of the Viscount crew. The fighter pilot parachuted to safety.

The wreckage of the Viscount and of the fighter aircraft was found to the east of Nettuno. The wreckage was scattered mainly over an area extending from the locality C. la Scimia to the sea, over a distance of about 2.7 km. The Viscount wreckage was mainly in the north part of the area and that of the fighter aircraft in the south part.

There was, however, no closest approach between the paths of the two aircraft, nor was a precise fix for their positions in port found, except for the fact that some of the heavier parts of the Viscount (two parallel fuselage segments) were towards the south end of the area. The nature of the fighter aircraft's trajectory must be considered abnormal, was found to the northeast of the area, a long way from the other parts.

### Missing Parts

A large number of parts were not found as yet identified as were broken into small fragments. On the starboard wing of the fighter, web parts of the wing track, the control surface hinge and the up-tilt of the wing were missing. The pilot's seat and the rear fuselage were missing. The wreckage was reduced to small and irregularly shaped fragments in small quantities to presume that the wing had exploded.

Again, in respect of the fighter aircraft, the port wing cut part was found which appeared to have been broken off by landing and then in the rear plane. The landing gear was missing, presumably as a result of collision with the leading edge of the port wing of the Viscount, between engine No. 1 and 2.

The jet engine was worked, its parts were tested and broken to parts. The bearings of the main shaft were torn off, the main shaft with the turbine was about 2 km. away from the wreckage. On the compressor only a few outer parts and some parts of the rotor were found.

The tail unit was also greatly damaged and without its leading edges. The horizontal section of the tailplane had disintegrated and was probably without control.

The only part of which a few moments remained was the fuselage from the forward air intake to the jet engine. The pilot's seat had been ejected from the cockpit.

The pilot's seat still had its oxygen cylinder intact and undamaged. There was a heavy impact on the midline of the bottom of the seat, opposite the upper body control section of the wing, which appeared to have been violently crushed up. The pilot's straps were missing and the corresponding parts were not found. The right part of the safety belt remained. The left part up to the seat attachment was crushed away.

The degree of penetration of the forward part of the fuselage, related to above, in contact with the condition of the seat part—strongly related to fragments by direct impact—leads to the conclusion



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that the landing was stuck, so at 210 psi two pistons at right angle to its axis, and therefore that at the moment of release the fighter aircraft was at a steep angle.

As regards the Vietnam, almost all the parts were found or identified except for:

- Arm III of the port wing.
- A number of small pieces from the left hand side of the top of the forward part of the fuselage (front, between the door and the cockpit).

•A great many parts of propeller (helicopter engine No. 2).

On the parts found, the following are notes of special interest:

- Engine No. 1 was the part which saved the helicopter.
- In propeller with part of the reduction gear, had two blades not short and as after two blades started into a 18, it also left a long way off.

This gives reason to suppose:

•Propeller No. 1 would have struck the port wing of the fighter aircraft (though not part of its structural strength, and would have become detached from the engine after its landing at the rubber bog spot).

•At practically the same time engine No. 1 would have become detached from the wing, following the disintegration caused by the support of collapse.

•Since the work related to the landing was great and the landing of the engine attachments to the wing may be seen as a job to be done in order to achieve

to the kinetic energy of the propeller was lost engine, it is to be presumed that engine and propeller detached close to piston such that the point of collision would be approximately along the diagonal along the ground at the two ends of wreckage.

#### Instrument Readings

The navigational instruments, which were photographed at once as they were found, read the following:

- Master indicator of the gyrocompass showed a heading of 173 deg true.

•Heading indicator of the gyro compass showed 136 deg true.

- On the indicator of the gyro compass (MDP) of the second pilot, the gyro needle was "grey" and the red needle at 31 deg.

The above indicators will show the Vietnam's heading of the manner of the collapse of the instrument in the power supply in the aircraft engine was instantaneous at the time of the collapse.

On the first pilot's indicator, the course needle was moving but the course had been past to 120 deg. The second pilot's indicator indicated 161 deg. T and was set at 134 deg. The main indicator is still on the new indicator control panel was put to the flight instrument position on the gyro panel, the indicator pilot was selected, but it was not possible to establish whether the electric control was also selected.

The gyrocompass with which the fighter pilot was used was for being 2.4 back

type. When witnesses remember seeing it displayed at altitude, but first you see it in the form of which the height of opening can be determined. The parachute came down into a tall tree. The pilot received assistance a short time afterwards.

On the ground, witnesses the parachute was found to be intact only the "gyro" "D" was missing. The parachute was not in operation at 15,000 ft. with a delay of 2 sec, it could not function normally, as the relevant safety pin was still in position.

The pilot remembers absolutely nothing about the descent, he had consciousness at the moment of the collapse.

It is assumed that the parachute read have opened he clearly indicates because of movement pull of the "D" ring on the surface at once probably because the "D" ring, still being entangled during the action of the pilot's seat.

Reconstruction of the sequence of descent of the parachute has been attempted, but the data for wind in the area was uncertain, so that reconstruction cannot be accurate.

#### Inefficient Data

Furthermore, there was not sufficient data regarding the height of opening of the parachute. It can be noted, however, that the point of descent of the parachute was about 500 meters and the point of fall of the pilot's seat.

The wreckage shows clearly that the instrument moved between the handrail and the Vietnam at the port side and the

under surface of the fighter aircraft which was in a steep climb.

The fact that only a few parts of the standard rig of the fighter aircraft were identified (found in different areas a long way off) leads to the hypothesis that the wing disintegrated. The disintegration might have been due to:

- Collision with the fuselage of the Vietnam between the forward door and the cockpit (area in which the structure has not been identified).

•Possible effect of explosion of the fuel in the wing tank of the fighter aircraft.

#### Fuel Borne

It is to be supposed that the fuel which emerged from the port wing tanks of the Vietnam also caught fire and contributed to the formation of the enormous dark cloud which is recalled by the witnesses.

Further evidence of direct collision is given by the locomotion protocol in engine No. 2 of the Vietnam in the wing events before and the subsequent wing end of the fighter aircraft in which indicates the engine was released to fragments.

The state of the landing edge of the port wing of the fighter aircraft gives reason to suppose that it collapsed in area A with the wing leading edge at the Vietnam, between engines No. 1 and 2.

From the statements of the pilot of the fighter locomotion from the possible attitude of the two aircraft and from their respective parts it can be deduced that at the moment of the collapse:

- Longitudinal plane of movement of the

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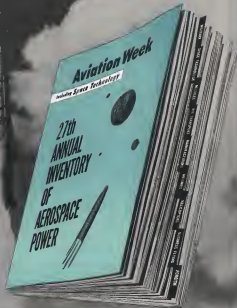
# The Navy's Polaris: from nowhere to anywhere

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# ANNOUNCING . . .



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PUBLISHING DATE: MARCH 7, 1960

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February 15, 1960

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## ARCTIC READY! BELL'S HU-1A

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rescue...*



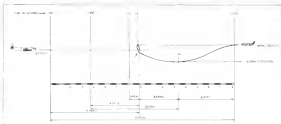
Last February, during its Arctic evaluation in Alaska, the Army's turbine-powered Bell HU-1A "Iroquois" was called on for an emergency search and rescue mission. An Air Force member was undergoing severe weather indoctrination at an Alaskan base. Suddenly a crewman accidentally alerted himself at high altitude and parachuted groundward. Minutes after the pilot initiated for rescue, a Bell HU-1A was on the spot hovering within inches deep snow, taking the crewman aboard. "Unusual mission? No, a routine job for the rugged HU-1A...the rotor bell for instant 'alert to airborne' performance anywhere, anytime!"

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## Always on Study... Regardless of Environment



DISTANCE of about 16 km. connected the heads of the wet lowland and the Vireonid when the first meadow started.

## Aircraft Systems

As regards the route through India an issue for flight 384-142 used the services of agents under the protection of MIA and Rome Air Control Center. The aircraft actually followed in the Vietnam zone, Areas 43 and 44.

In compliance with current control procedures the Vacuum unit is commanition with Video Control from down Most Blank to show Full M20 (south limit of Video Flight Instru- tion Range).

It was then at communication with Roger Constant and Jean Omer.

The Vietnam contact was reassigned to the North Milan Control at 0025 h on 1975 (the aircraft was above the N200 and was transferred to the Rome North Sector Control. In communication with Rome Control on 3193 m, the aircraft was given clearance to fly up to Code 4000 N200 (1110 ft) and then transferred to the Rome South Sector Control at 0755 E.30).

At 1144 hr, the Vietnam reported flight over Chu NDB and requested flight over Point NDB for 1147 hr. At 1145 hr, Rome Control, following reports received about an accident near Yuma, reportedly called the Vietnam without obtaining a reply. Immediately after receiving news of the accident, Rome ATIS/TIC and Pointe de Marse Base notified the Air Base services with the regular DISTRAPPA message.

### Radio Transmissions

At approximately the time of the accident (approximately 11:00 hr) the following communications were received and recorded at Reno, NV:

BOYED advised flight over Oahu

- On the same frequency, at 1150 he contacted another from another aircraft still relaying to flight over Oahu
- On 1249 Gc, at 1150 he 50 sec. later communicated from the aircraft "Walloo 525" which reported sighting the cloud of another "Walloo 525"

There was no doubt that there was another

very, a long way from the two groups

- No smoke showed (absence of smoke trails or evidence which had another broken, for instance)
- There was no sighting of the fighter formation until the outbreak of the kamikaze landing
- The reason why some formations did not see the other, is that before the collision

## Prohibited Areas

There is no doubt that the collision occurred inside the main, as an example it will leave us to  $p_{\perp}^{1/2}$  level. In fact all the witnesses agree in locating the dark cloud following the collision as over the head in the east of the Vennet the wreckage shows that it was coming from a source approximately to the north east from the hypothesis of a collision.



MAP SHOWS relative of the creek area (near Napa and Ordo). The river is probably in civil unrest.



## Marine Corps Turboprop Tonker Makes First Flight

Lockheed GV-1 turboprop (an advanced C-130 Hercules) and tonker developed by Natick and Marines makes first flight from Locklebury, Mass., on Feb. 16. Refueling choppers are extended from pods along under wings. Fuel is stored in a 160-gal internal tank.

lines occurring on the eastern edge of the storm, the wreckage could not have fallen in the place where it was located nor have been distributed in the same way, allowing for all the circumstances.

The references given in the statements of PANTALINO (at Natick) and PRODUYI DELEITE (at the Gulf's bureau) are sufficient to locate the collision as an area near head of Penobscot.

When located, a time-lapsed exposure of the distance from Oates 145 (km) to site (km) in the (approx) hour (about 1 km) and to the speed of the Vietnam 1450 (km/hr), the elapsed of (approx) No. 1 and proper No. 1 and the critical data (approx) and the distribution of the wreckage of both aircraft.

### Vietnam Heading

It is only known that at the moment of collision the Vietnam was moving, from a vector approaching to the southeast, the wind force was significant, in addition to the speed of the Vietnam 1450 (km/hr), and at 1144 hr, the Vietnam (approx) that it was over Oates NDB and extended to head for Tonk.

At 1150 hr the collision had already occurred, as a location approximately 40 km away from Oates NDB.

The time of 5 min is brief sufficient to cover the distance from the reporting point (Oates) to the point of collision.

From this it can be deduced that the collision was most likely approximated very closely at the last point of the, this point in other words, it does not seem possible that the Vietnam, on that portion of the flight, made any considerable deviation from the direct track.

The following three hypotheses can be for a detailed deliberate deviation, driven on account of second collision with the lighter aircraft, deviation in account of support aircraft.

No. 1. Steering from a point over Oates the pilot might have deliberately headed for the report of destination (Naples) then

about 1207 hr, at 1:00 of the hour, he began to cover the distance Oates-Penn-Naples (35 min) and the avoidance, as traffic procedures (1 km).

It may also be noted that once Oates the pilot did not wish to begin the descent, as indicated on the flight plan.

A deviation of about 10 km, at 23:00 hr, closed by Route Air Control Center. The Vietnam's arrival from an approach (approx) southward vector (deduced from the distribution of the wreckage), would agree with the above hypothesis. More detailed confirmation of this deviation would have to be obtained from the position of the course recorder (175 deg and 178 deg) based on the vector indicator and some records and from the relative bearing of 52 deg indicated by the radio compass if it were assumed to be probable, that the great angle in the aircraft's attitude was interrupted instantaneously at the moment of collision.

Against this hypothesis, it must be considered that such deliberate action (if not to be excluded entirely, seems very unlikely, were the service crew in the cockpit, the Vietnam pilot was less judged that there was no real risk in passing through the Philadelphia Area, which was very short of the point, to Naples.

It can be observed in this connection that the arrival at Naples of Flight 142 was scheduled as the breaching of the service for 1210 hr. In this, the Vietnam had reported passage over Oates at 1144 hr, it would not have arrived at Naples before

No. 2. The pilot found that he was flying over the port edge of the storm, might have been led to leave the storm, in order to avoid the lighter aircraft which was then a long way off, may have appeared to him to have been coming and maneuvered in the track of which collision happened as the service could be perceived.

The acceptance of such a hypothesis



## French Corrier Undergoes Sea Trials

First French missile cruiser, the Chevalier, doing the harbor at Brest, it also for sea duty in 1963 (AVW Dec. 7, p. 197). Chevalier will carry 48 cruise missiles, mainly Douglas Blandford 4 strike fighters and Breguet Alouette sub-surface planes. Cruise launching deck stretches about 190 ft, off main deck at 8.7 deg angle.

back to the arrangement that the crew member of the Vietnam, having seen the lighter aircraft maneuvering to the right of the survey and judging that they were heading for the survey staff, would have turned to the left.

Against this hypothesis is the condition that the Vietnam pilot would not only have to have seen the lighter aircraft in an impossible distance but even to have estimated their track with such accuracy that he was able to assess the probability of a collision and have the survey accordingly.

Furthermore, as this hypothesis is based on the presupposition that the Vietnam pilot had seen the lighter aircraft from a long way off, he would logically have maneuvered, after leaving the survey, in order to keep these aircraft steady within sight. Under these conditions it is difficult to explain a collision on the sea.

### Hypothesis No. 3

The pilot actually intended to fly above the Oates Point Area, might have, gradually and subsequently left it on account of support aircraft.

In favor of this hypothesis it must be noted that recognition was being made under the following conditions:

• On the day of the accident the center of the wind in the vicinity of Brest was somewhat irregular over the coast of the Upper Peninsula, in particular strong offshore winds were blowing, but at Brest they had changed to generally the opposite direction and the vessel was in force.

• Crews knowledge of the weather was not as obtained from the former service, as the weather was known, but they had in any event to adjust the direction for drift in accordance with local observations of the local weather.

• Aerially did not carry VOR equipment.

• Radio compass (USF) tuned in to stations frequency radio location (approx) types given (approx) available (approx) time.

Under the hypothesis as the result of rapidly varying data, the Vietnam might have flown on the headward side of Oates NDB when at 1144 hr, it appeared to over the NDB.

From here it would have continued on a route due to the center edge of the survey, going (approx) 10 km away from the center line of the survey staff.

Against this hypothesis is the fact that the recognition from London to Oates was not made and regulated and also the consideration that the crucial visibility conditions between Oates and Penn made it possible to track Penn in the direct area without any difficulty.

It should also be noted that in the survey between Oates and Penn the survey is conducted within the Philadelphia Area which would obviously have given more to the Vietnam pilot to correct potential error in the conduct of the approach.

### CONCLUSION

The Committee gave the following view on the probability of each of the three hypotheses.

## PROBLEMATICAL RECREATIONS 1



Three men, A, B, and C, with their wives A. B., and C. beg some objects. Afterwards each finds that the average cost in rupees of the article he or she has purchased is equal to the number of his or her purchases. A has purchased 23 more articles than B and B has purchased 11 more than A. Each husband has spent 85 rupees more than his wife. Who is the husband of whom?

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## General Electric Develops Fourth T64 Version

Fourth turbo-prop version of the General Electric T64 has been designated the T64GE-4 and contains the propeller reduction gear along the engine's mainline. Other versions are in development, a turbo-prop and another turbo-prop (AWJ, p. 61), developed under a \$50 million U. S. Navy contract. New version performs 2,000 shp at a specific fuel consumption of 0.596. Weight is 713 lb. Computer is operating four T64 test cells.

- Five members consider hypothesis No. 1 (shallow division) to be the most probable.
- No member considers hypothesis No. 2 (division on instant of knock) sufficient with the lighter scenario to be the most probable.
- Three members consider hypothesis No. 3 (division on instant of knock) sufficient to be the most probable.

As previously stated, on Oct. 22, 1914, the Vietnam C-4000 was reported to have been involved in a collision with the Vietnam C-4000. The collision was reported to have occurred at 11:00 a.m. on Oct. 22, 1914. The collision was reported to have occurred at 11:00 a.m. on Oct. 22, 1914. The collision was reported to have occurred at 11:00 a.m. on Oct. 22, 1914.

The scenario of the crash between London and Saigon was found to be consistent with the flight plan. This is shown from cross-section of the debris scattered around from the wreckage of the aircraft.

The witness of the crash between General and Saigon was also personally involved in the accident. The flight plan, according to the times of availability of the various reporting points. The crash occurred at 11:00 a.m. on Oct. 22, 1914. The crash occurred at 11:00 a.m. on Oct. 22, 1914. The crash occurred at 11:00 a.m. on Oct. 22, 1914.

The collision between the Vietnam and Saigon was found to be consistent with the flight plan. This is shown from cross-section of the debris scattered around from the wreckage of the aircraft.

The collision between the Vietnam and Saigon was found to be consistent with the flight plan. This is shown from cross-section of the debris scattered around from the wreckage of the aircraft.

report of the accident, but the witness was not on the ground at the time of the crash.

In view of the Vietnam's history, from Oct. 11, 1914, and of the scenario maintained up to that time, it appears that the Vietnam C-4000 was involved in a collision with the Vietnam C-4000. The collision was reported to have occurred at 11:00 a.m. on Oct. 22, 1914.

The formation of the T64GE-4 was found to be consistent with the flight plan. This is shown from cross-section of the debris scattered around from the wreckage of the aircraft.

The witness of the crash between General and Saigon was also personally involved in the accident. The flight plan, according to the times of availability of the various reporting points.

The collision between the Vietnam and Saigon was found to be consistent with the flight plan. This is shown from cross-section of the debris scattered around from the wreckage of the aircraft.

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The collision between the Vietnam and Saigon was found to be consistent with the flight plan. This is shown from cross-section of the debris scattered around from the wreckage of the aircraft.

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